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The AUTOMOBILE

Most Accurate Automobile Part

Methods of Ball Bearing Manufacture Call for Microscopic Inspection of Material and Product

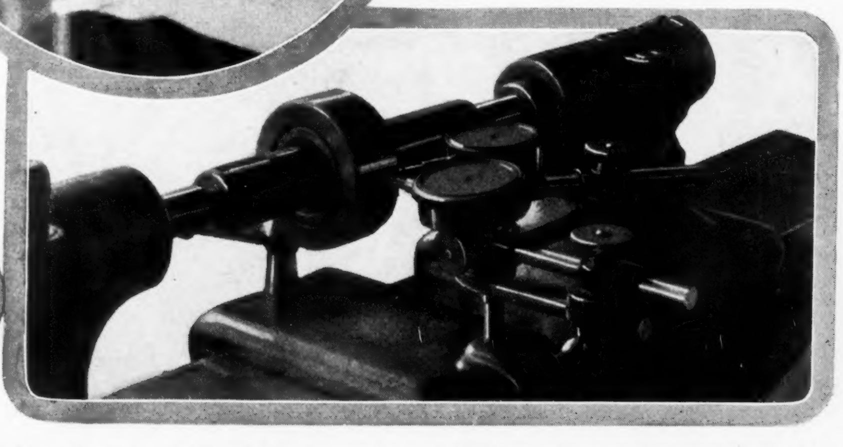
By A. Ludlow Clayden

THE ball bearing and the automobile are reciprocal in that the former has reached its present high state of efficiency by reason of the automobile makers' demand, while the efficiency of the motor car is due in a considerable degree to the friction eliminated by bearings having rolling instead of sliding friction. Yet few people who benefit by the modern bearing can have much idea how delicate a process its manufacture has become. Probably the largest factor in ball bearing efficiency is accuracy of dimension, and this is already such that a ten thousandth of an inch is the limit of error. Makers of bearings aim at an ever-increasing accuracy and it is anticipated that bearings will be made to much finer limits than this, as knowledge is gained concerning processes and materials.

It is easy to say one ten thousandth of an inch, but it is not easy to realize what an excessively small dimension this is; it is possible to get an idea by thinking of the sixty-fourth of an inch marked on most engineers' scales and then remembering that dividing this into a hundred parts would give units considerably larger than those to which ball bearing makers have to work.

To obtain this accuracy it has been necessary to devise special machines, to discover special materials and special methods of treating those materials, and, above all, to train inspectors and workmen to use gauges such as ordinarily are found only in scientific laboratories. This work has been done by various manufacturers in different parts of the world, and the development has mostly been along independent lines, though the results are similar.

America was admittedly behindhand in ball bearing making and up to the past summer an estimated proportion of foreign imports to home production was fifty-fifty. The recent embargo on exportation from Europe will act as a stimulus to American business and will encourage expansion of the American makers' plants, so that there is good reason to hope that the country will be self-supporting in this respect when the war is over. That it has not been so before is doubtless due to the highly special nature of the business, and to the fact that American



Upper—Watching through a telescope the movements of the tiny mirror that shows how a steel ball flattens under load. Lower—A finished double row bearing being tested for circularity and truth of face simultaneously. Each of the two gauges shown will indicate much less than a half thousandth of an inch variation from proper size.

makers have had to train themselves and their men before they were ready to produce equally good bearings. This they are now able to do and can, therefore, prepare to expand their factories to supply the home demand completely and ultimately this will carry competition abroad.

Highly Special Material Used

The essentials of a ball bearing material are hard surface and tough core, but beyond this the hardness of every spot on every part must be even. Extra hard places mean inaccuracy in the grinding operations and increased rapidity of wear in use. The New Departure Mfg. Co., Bristol, Conn., whose process of manufacture is dealt with in the following pages, has had difficulty in getting sufficiently pure steel from other than Swedish sources of supply, but is now obtaining American made steel that is proving good. Three forms of material are used, bar for making small bearing races, tube for making larger races, and drawn wire in various sizes for making the balls. For the moment we will neglect the races and deal solely with the manufacture of the balls.

Balls Made Automatically

This commences with the annealing of the steel wire which is performed in large furnaces designed and made specially for the company so that the coil of wire is heated evenly and also protected from the atmosphere or other scale-forming gases. After the annealing process the next operation is to draw the wire again, so reducing its diameter slightly and consolidating the steel. The New Departure Co. find they can get better results by doing this final drawing in their own plant than by taking the wire as it comes to them, and since they have only to make slight reductions in diameter four drawing mills are able to take care of the whole output, dealing with some 15 tons of material daily.

From the moment that the wire leaves the building in which it is annealed and drawn the making of the ball is automatic. In an adjoining building special machines automatically cut off "slugs" from the coil of wire, and each slug is dropped between a pair of cup dies which stamp it into a roughly spherical form. Although the dies which do the stamping make the ball roughly there is left a fin or ragged edge of metal round the junction of the dies, and this is removed before the balls go to the heat-treating furnaces, by a rough grinding process.

Returned to the heat-treating plant the balls are poured into iron trays and placed in a gas-fired furnace where they are raised to a very exact temperature before hardening. For control of this temperature the best and most accurate electric pyrometers are used and connections are made from each furnace to a central board located in a separate room. Here one man spends his days checking the temperature of one after another of the row of furnaces over and over, each furnace being tested for heat every few minutes. Should it be too hot the movement of a switch lights up a lamp suspended over the furnace in error, and should it be too cold, a different switch turns current through a lamp of different color. Thus when neither lamp is alight the temperature is correct and all the foreman has to do is to give attention to those above which the lamp calls for either more or less heating.

As the balls are made of steel that is hardened completely they have no casing process to go through.

Ball Grinding Is Slow Process

After hardening, the balls are fairly round but have a black exterior, so there remains a good deal of metal to be removed. The way in which this is done and the ball brought finally to within a ten thousandth of an inch of correct size is by causing the balls to roll in a vee groove in the presence of an abrasive material. In the ball finishing shop are rows of machines with horizontal spindles bearing the grinding plates, and these plates have spiral vee grooves cut in their faces, so that balls may be fed to the center of the plate and taken from the outside continuously. The process is automatic since the balls leave the bottom of a hopper, pass through the grinding groove and return to the hopper; every now and then a man takes a ball from the machines and checks it on a gauge to see what progress is being made, but the steel is so hard that it takes hours to bring an average hopper full of balls down to finished dimensions.

Sorting Machines Are Automatic

Even when this process is over the balls are seldom exactly the same size, variations of tiny fractions of an inch being detectable by delicate gauges; however, before they are sorted and graded into size, the balls are put in tubs mounted on shafts at about 45 degrees to the horizontal, mixed with small bits of leather. As the tubs are revolved the balls roll over against each other in their efforts to keep to the bottom of the tub, and this continued friction against the leathers puts on the high polish which one associates with a bearing ball.

The next process is to sort for grade so that a load of balls with a maximum inaccuracy of a ten thousandth may be sifted into lots with still smaller differences. Again the balls are put in a hopper whence they issue one by one and fall on a pair of vee edge pieces of steel. Beneath these strips is a sort of worm with a deep square thread and a pitch slightly greater than the ball diameter. The thread takes hold of the bottom of the ball and pulls it along the strips where, since the outer ends of the strips are a fraction wider apart than the inner ends, the ball presently falls through between them; the larger it is the nearer it has to be drawn to the outside, and the smaller it may be the shorter the distance it travels. The ball drops into one or another of four or five different boxes, according to the exact spot where it slipped through the runway and these boxes are used separately in assembling bearings, so that there shall be the minimum deviation in size between all the balls in any particular journal. The sorting machine can also reject balls over or under the limits of size permitted.

Human Eye Is Final Test

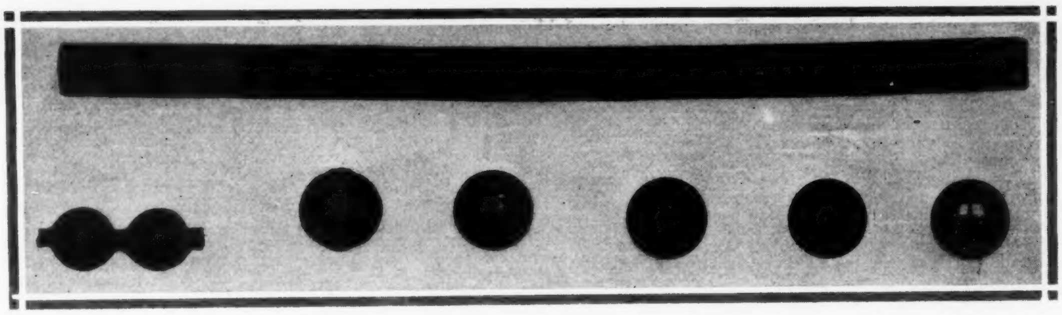
Finally the balls are given to girls skilled in examination by eye; placed in wooden trays some dozens at a time it is just possible to see faint differences in color due to slight difference in hardness. So skilled are these girls that they can pick out a ball which is wrong almost before the tumbling, glittering spheres have come to rest in the tray, and it is interesting to see that a good many balls not quite right do manage to get through even the rigorously careful processes we have dealt with. Of course the percentage is extremely small, but obviously the makers wish to run no risks whatever and prefer to waste a good many balls rather than risk one bad one in a bearing.

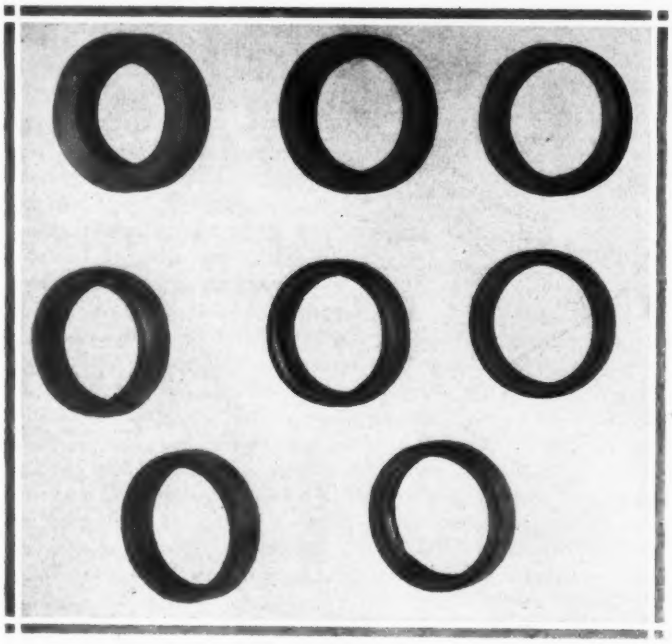
Roughing the Races

So much for the balls, the most accurate and the most difficult to make of ball bearing parts. The races are comparatively a simple job, the skill of the craftsman showing up more in the hardening furnaces, perhaps, than in the machine shops. For these races either bar or tube stock is used according to the size, and there is one big shop full of automatics which make the inner and outer parts of all the New Departure bearings. Some of the immense races made for special heavy jobs far outside the automobile range of sizes need hand turned races, but these are only a very few.

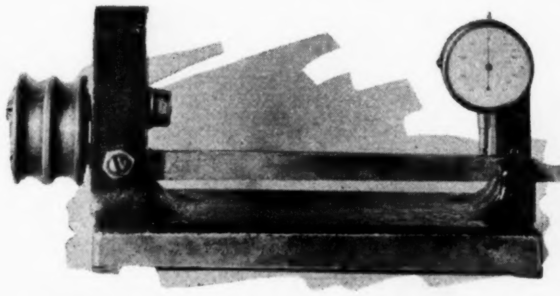
High speed production is the order of the day in the automatic room, because great accuracy is not important since all this appears in the grinding processes which follow case hardening and tempering. Judged as a machine shop process

Steps in making steel balls. At top is alloy steel wire, then, reading left to right, portion of string of rough forged balls, ball separated from string, with flash removed, rough ground ball, same after heat treatment, finish ground ball and polished ball finished and ready for service





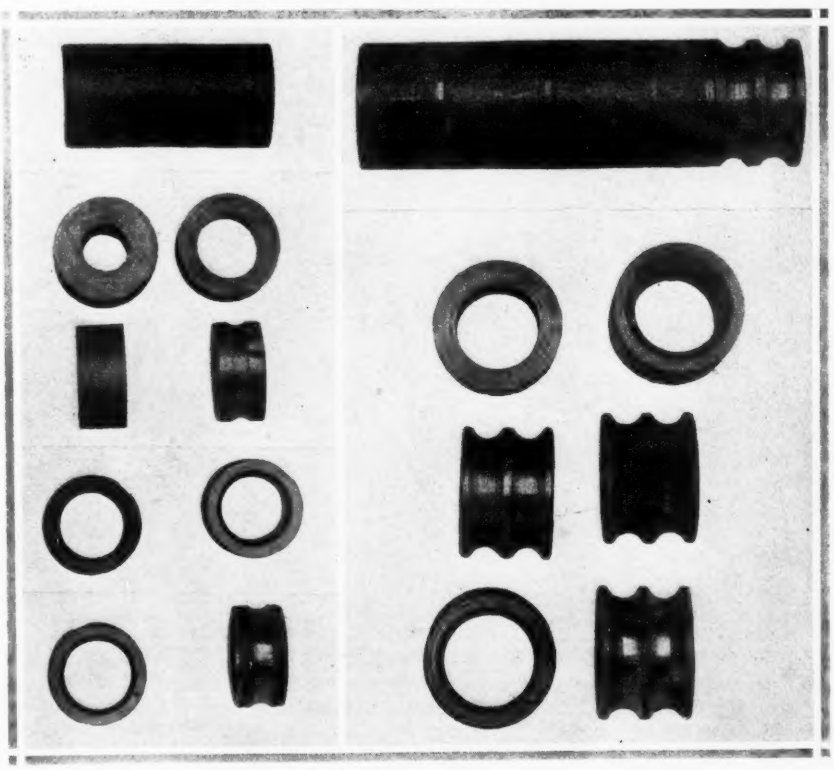
Operations in machining single row cup. At top is a piece of chrome steel tubing. Reading from left top, we have blank as cut off from tubing, blank faced and bored, outside diameter turned, cup shaved all over, ball race formed, cup stamped, heat treated, face ground; outside diameter finished ground and ball race ground

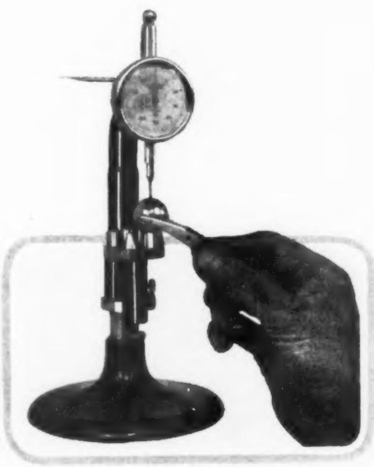


Multiplying indicator gauge for measuring cone bore. Multiplication about 10 to 1. A .0001 inch variation in cone will register one graduation on dial

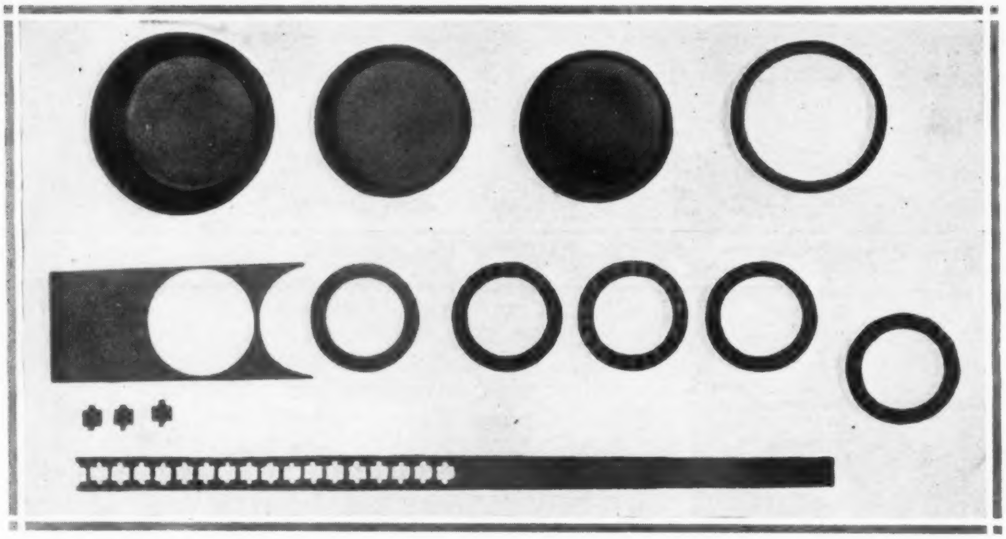
Below—Left—Operations in machining single row cone. At top is a piece of tubing. Below, reading from left top, we have blank cut off, blank bored, blank outside diameter turned, ball race and milling groove machined on blank, cone heat treated, face ground, bore ground, ball race ground

Right—Operations in making double row cone. At top is shown piece of chrome bar stock with cone as formed by automatic machine before cutting off. Below it, at left top, cone after cutting off, after facing and chamfering, shaved all over, heat treated, bore ground, and, finally, cone with ball races ground





Showing dial indicator fixture for testing size and sphericity of New Departure steel balls. Each graduation shows 1/10 of .001 inch variation. The ball is held in a pair of horn tipped tweezers so the heat of the hand will not cause it to expand



Showing stages in making pressed steel parts used in New Departure ball bearing construction

Top—Reading from left to right shows the stages of pressing out from sheet steel the external case which incloses the double row bearing. Beneath is the cage for single row bearings, in its several stages of pressing, and the bottom series shows the little rivet used to connect the two halves of the cage

the roughing of the races is about as simple a job as could be devised.

It is also true that in the grinding rooms the machines used have no special ingenuity in design; rather they are very rigid and delicate of adjustment. Given a machine that can be trusted to work within minute fractions, it is left for the skill of the operators to produce good work. Each man has a limit gauge which is so close between the "go" and "not go" that great care is necessary, and on most of the tools there is also a registering dial gauge which can be held against the work so as to show any deviation from roundness as the bearing ring is revolved slowly. Naturally the upkeep of these gauges calls for a minute inspection of them and quite a small works is kept going on the making of new gauges to replace those that wear out, as many of them do fairly rapidly.

For case hardening and tempering the raceways the same pyrometric plant is used as that described in dealing with the balls, and the same degree of care is observed.

Assembling Most Important

Though a man skilled in the use of machines can appreciate the wonderful skill of the New Departure operators, whether in grinding shop or heat treating plant, it is in the assembling bays that the average man would find it easiest to appreciate the procedure. The balls come hither sorted in the way described and they are used up a boxful at a time. For the single row bearings the balls go in between the two races while the latter are held eccentric, and when the full complement of balls has been introduced the race is passed on to another operator who separates the balls and uses a machine that clips the retaining cage in place. This cage is made of sheet steel and is produced by stamping.

For the Radax bearing for thrust, which is practically a cup and cone bearing, the balls can be clipped in the cage separately, as the bearing can be taken apart at any time. These processes are not peculiar to the New Departure company, but there is a special scheme in use in this plant whereby single row journal bearings are assembled so that the balls are always gripped at the same "tightness" between the inner and outer races. Thus a boxful of balls a microscopic fraction over size will not make tight bearings, nor will a boxful of slightly small balls produce bearings in which the balls are loose. This is important because the life of a bearing depends upon the proper original tightness to a very large extent.

Special Feature of Double Row Bearing

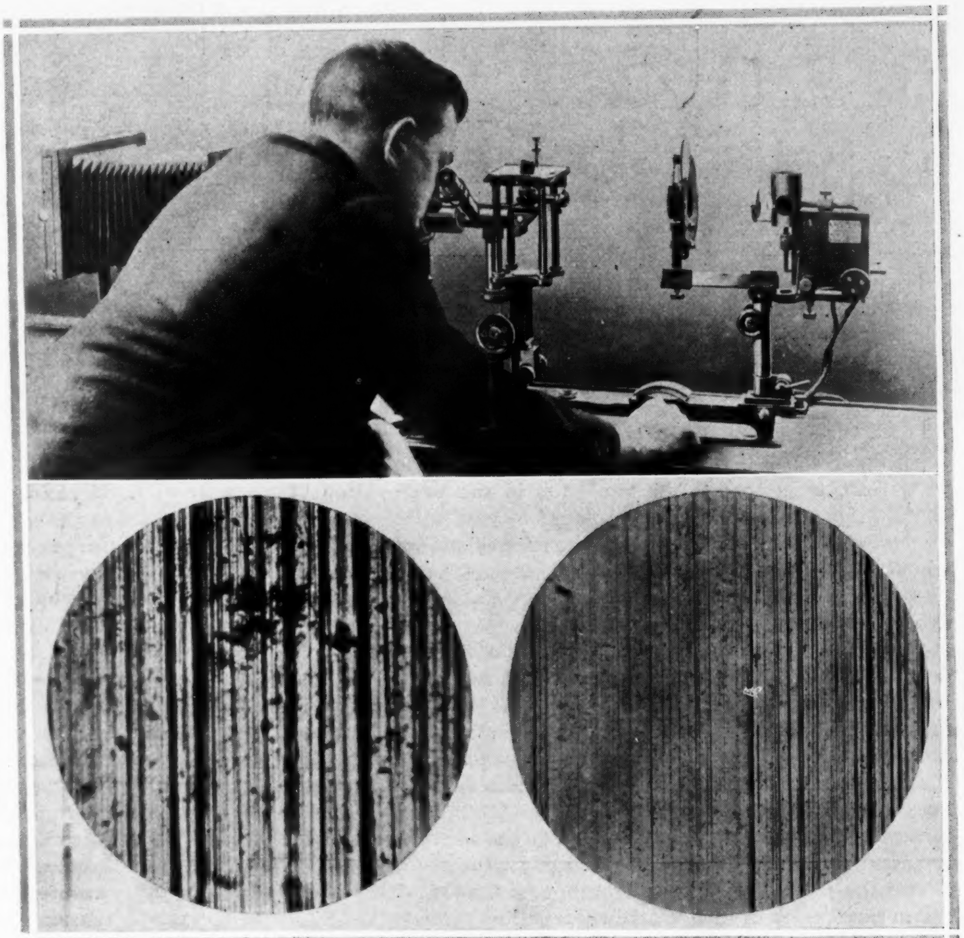
For the double row bearing which is the New Departure specialty quite a different assembly scheme is followed. Turn-

Left—Machine for testing elasticity of balls. Three balls are mounted one above the other so as to give point contact for the center one. As this is flattened by load a tiny mirror reflects a spot of light to a scale 10 feet away. The telescope shown on page 701 reads the scale and a deflection of less than one ten thousandth of an inch can be seen. This test determines the elastic limit of a ball and so the safe load for service. Right—A machine for testing eighteen bearings under load. Center—A smaller machine which applies both radial and thrust load. These machines give much valuable data and are in constant use in the laboratory

ing to the picture of this bearing, page 705, it can be seen that the cage is a solid piece of metal instead of being a steel pressing. To be accurate, the cage is two pieces of brass, one serving for each row of balls, this being done to allow one row of balls to revolve faster than the other if any difference in size or load should produce conditions where this would be the tendency.

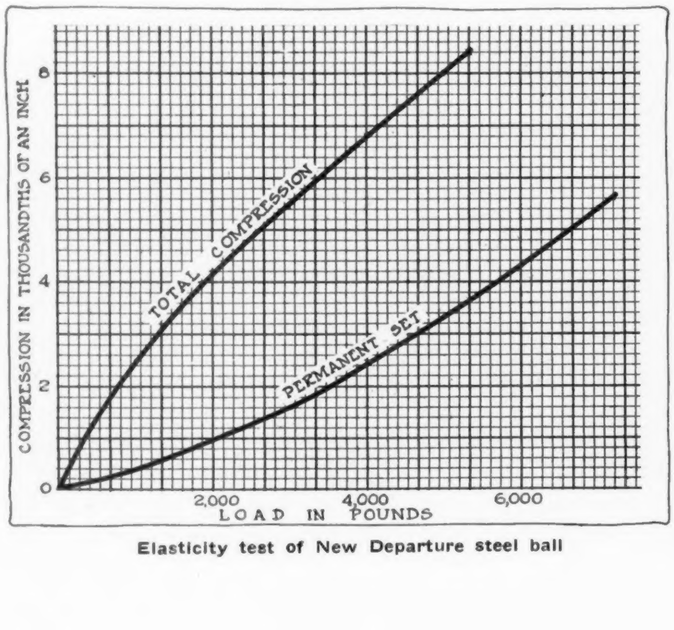
Having got the two outer races, the inner double race, the balls and the cages, the remaining part of the double row is the outer shell. This is pressed into cup form from sheet steel of a softish sort and the bearing is put together by dropping the parts into this cup in proper sequence; first an outer race ring, then the center member, the two cages and all the balls, and finally the second outer ring. These parts are held tightly by the outer shell, since the rings have to be pushed in by a small press, and the next stage in assembly is to mount the bearing on a lathe and spin over the open end of the cup of soft sheet steel.

When the spinning is done the bearing looks like the finished article, but it is very tight indeed, so tight that it cannot be turned, and to render it just sufficiently loose it is gripped in a chuck and a man bears on the outside with a sort of burnisher. This heavy pressure on the soft steel causes it to flow, just as the end did in being spun over, and the harder the pressure the greater is the deformation of the case. Squeezing the rim in this way causes the spun-over end to slacken its grip, and a few moments suffice to loosen the races so that the bearing spins freely.



Examining the finish of ball bearing raceways with a microscope. Beneath on left is a poorly finished race magnified 1,000 times; on right, a well finished race magnified 1,500 times. The finish has a great effect on bearing durability

We now have the finished bearing, but the outside of the case is scored where the burnisher was used to loosen the inside parts, so the next thing to be done is to grind the outside in order to remove the tool marks and bring the diameter of the complete bearing within the prescribed limits of size. Since this is liable to introduce small quantities of grit to the races the bearing is put on the last machine of all, which washes it out by forcing oil under pressure through it. It is then ready for final examination, oiling and packing in grease proof paper and the familiar cardboard box.



Elasticity test of New Departure steel ball

Laboratory Equipment Elaborate

Not the least interesting part of the New Departure plant is the elaborately equipped laboratory where steels are tested both physically and chemically and the finished bearings or their parts are tried out for durability or load capacity. The nature of the product makes it imperative that material be checked very closely indeed so the number of samples taken from steel stock is far greater than that thought necessary in ordinary manufacturing. Naturally, microscopic examination plays a big part, and this is used extensively in watching the hardening and tempering processes also. Several different machines are installed for imitating various conditions of service, and the bearings are run to destruction under circumstances that are close to those of actual use.

If the same care were taken in the mounting and use of ball bearings as is taken in their manufacture we should seldom hear of unexpected failures, but as this is a subject worthy of separate treatment we propose to leave it for the present and deal with the usage of ball bearings at another time.

It may, however, be remarked that there are very few bearings used on automobiles which receive proper treatment by the users, and, satisfactory though ball bearings are, they would be infinitely more so if their treatment was as good as they are themselves.

Steel—
Its Pathology

Part III

Heat Treatment Alters Intermolecular Structure and Governs Physical Characteristics

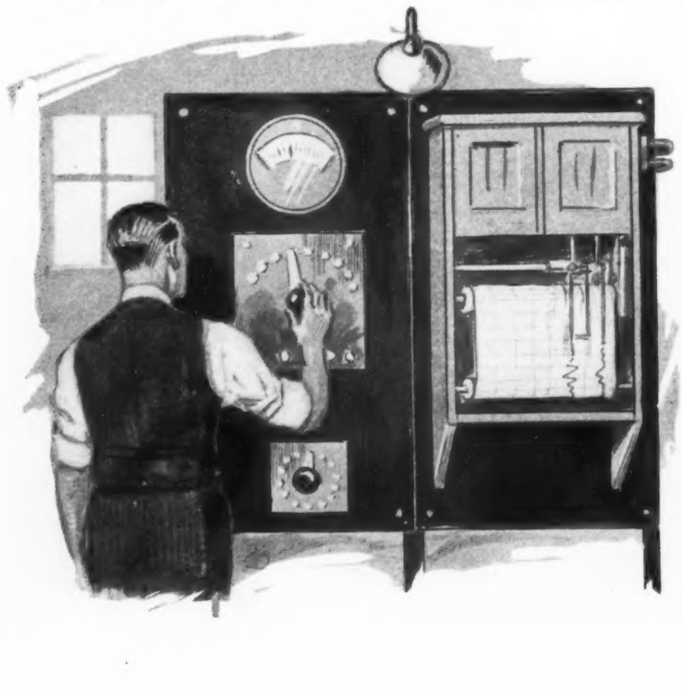
By J. Edward Schipper

HEAT treatment is the final step in the preparation of the steel. The bath of flame is now called upon to do its work and second the efforts of the elements which went into the formula for the steel. The formula determines the chemical specifications but the heat treatment determines the physical.

Thus far it has been shown how the metallurgist, the doctor of steel makes changes in the characteristics of steel by the addition of this medicine or that tonic. The metallurgist, like the physician, has, by the writing of the proper prescription, treated his patient and cured the ills due to impurities in his system or given him the strength needed to meet the daily tasks. The final chapter, heat-treatment, is the most wonderful. It is the fiery furnace and the marvels of transformation which it performs which really allows the metallurgist to fully reap the results of his careful arrangement of the ingredients in the prescription.

It can readily be understood how adding a substance of certain qualities will produce changes due to the inherent nature of the substance added, but here we have wonderful changes which are wrought by heat alone. By a proper manipulation of temperature, a steel can be taken which is diamond hard and rendered soft enough to be beaten into any desired shape with a hammer, or, inversely, a steel which is soft and pliable can be raised to a high temperature and plunged into ice water and rendered hard and brittle.

There is no analogy for heat-treatment in medicine. The physician cannot plunge his patient into a high temperature and then by suddenly chilling him in water produce health. The metallurgist, on the other hand, is compelled to use this treatment if he will obtain the full benefit of the ingredients in the steel. Nothing is added and nothing is taken away, and yet, by heat alone, steels of the same composition can be given such widely varying characteristics that it is almost unbelievable that they are in any way related to one another.



Changes Structure

The reasons for the changes made by heat-treatment in the character of steel are directly concerned with the structure of the metal. Steel like sugar, salt and granite, is a crystalline, as opposed to amorphous, substance like flour, wood, paper, etc. The knitting together of the crystals which go to make up the structure of the metal into different shapes and combinations has everything to do with the strength and physical characteristics of the metal. If we have a few coarse crystals, relatively speaking, the steel will be hard and brittle. If we have a large number of very fine crystals generally it will be strong and tough.

Heat treatment alters the sizes of the crystals, changes their entire arrangement and hence definitely controls the physical characteristics of the metal.

The crystals comprising the interior or inter-molecular structure of the steel are not all of similar composition but vary in their nature. Thus, if there is a preponderance of soft crystals, the resulting composition will be softer than if the preponderance were of the harder ones. One of the methods by which heat treatment alters the conditions and characteristics of the steel is by changing the number of hard crystals in relation to the softer ones and again this process can be reversed and made to work either way.

Steel is composed of carbon and iron which ingredients intermingle in various ways, the iron alone being soft but certain combinations of iron and carbon being as hard as the diamond. Heat controls the iron-carbon combinations, which in turn influence the entire structure of the metal. Thus by adding nothing but merely by changing the inter-relationship of the molecules, which go to make up the structure of a metal the fiery heat-treating furnace can be said to literally perform miracles.

Three main divisions of heat treating exist. They are annealing, hardening and tempering.

Annealing is for the purpose of effecting a rearrangement of the molecules after they have been distorted and deranged through working the steel at a temperature in which the displacement of the molecules is possible.

Hardening which is generally employed to prevent parts wearing is accomplished by quickly quenching the steel in cold water or some other liquid bath after it has been raised to such a temperature that the carbon is in solution with iron.

Tempering is practically a compromise between annealing and hardening and accomplishes to some degree what both the other two do. It is accomplished by quenching in a slow-cooling medium, and is for giving parts desired strength.

The explanation of the processes which permit annealing, hardening and tempering involves many mooted points, but there are certain well-defined principles generally accepted.

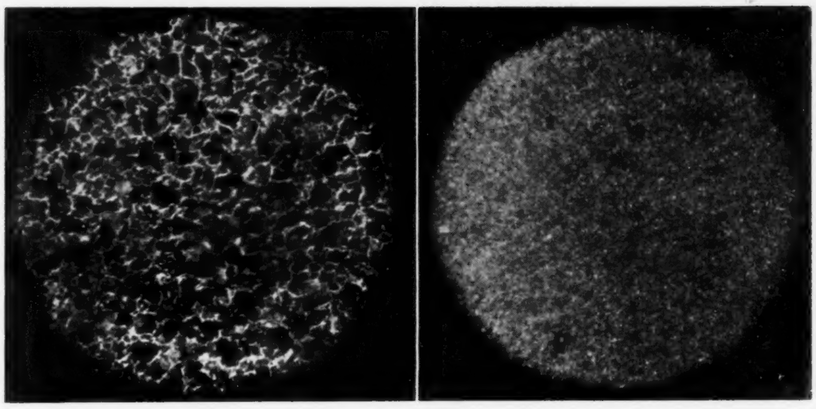
Iron, the Foundation of Steel

Iron, in steel, is the foundation. In steel it may be compared with the metal skeleton in the sky-scraper building. It is the basis of the entire structure of crystals of which the

steel is composed. Take away the iron and we would have left only a mere shell, and hence, changes in the condition of the iron would naturally be supposed to make marked differences in the condition of the steel. It is like the blood in the human being. When it is thin and watery an anaemic condition results, so with the iron when it is in certain conditions, the resulting structure is weak and lifeless.

In metallurgy, iron exists in three distinct conditions which are governed by its temperature. These three are known as alpha, beta and gamma or Greek A. B. C.

Alpha iron is iron in the familiar condition at atmospheric temperature. It has well defined crystalline structure, it has the quality of being able to be rendered magnetic, and in many steels can be seen through the microscope as a light gray formation in practically pure condition.



Left—Chrome-nickel steel in the normal condition as rolled. Right—The same steel after having been heat treated by raising to 1,525 degrees and quenching in water followed by 1,000 degrees draw.—United Steel Co.

If however, iron be heated to about 760 degrees centigrade, it undergoes a distinct change of condition. It becomes practically non-magnetic and possesses various other physical characteristics not previously possessed. It is now in the beta condition.

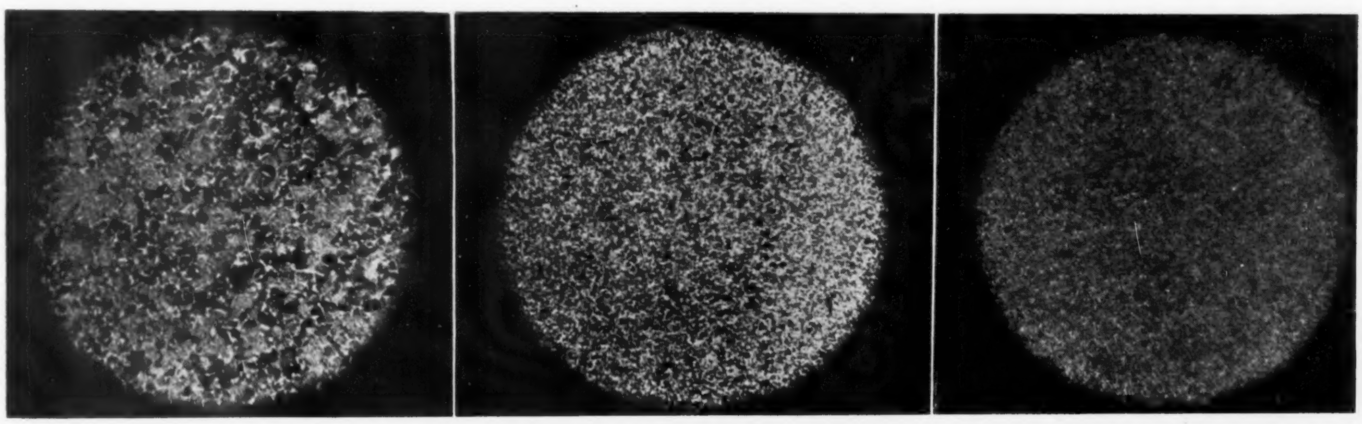
If it be still further heated until 890 degrees centigrade, it becomes gamma iron, where it again changes in many of its physical characteristics becoming entirely non-magnetic and having the quality of being able to take up carbon in solid solution. The temperatures at which these changes take place are known as the critical points and the alpha, beta and gamma conditions are only seen in the laboratory during the periods of transition in heating the metal.

Since steel is so largely made up of iron, the changes which take place in the iron at the critical points have a marked effect on the qualities of the steel. Thus if a steel were heated to a temperature well above the point where iron passes into the gamma stages its structure and quality would be altogether different from what they were at atmospheric temperature. During the period of heating the iron would pass through the alpha, beta and gamma stages and consequently the steel itself would have passed through well-defined conditions due to the varying qualities of the iron at these temperatures. If the steel were then allowed to cool slowly at the time it again reached atmospheric temperature, it would have returned to its original state practically without change. During the cooling, however, the steel would have passed through each of the well-defined stages, A. B. C. that it had during the heating, except in inverse order.

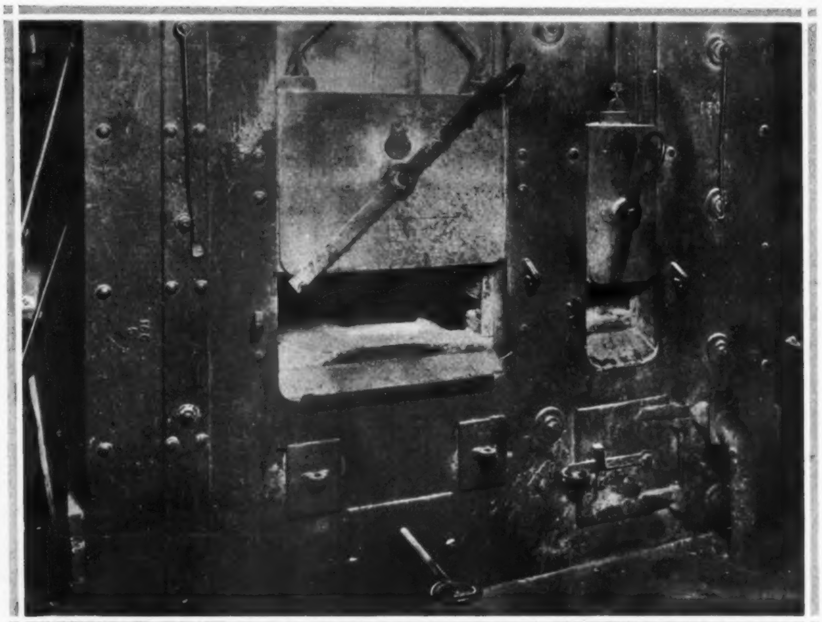
If the steel, instead of being allowed to cool slowly, were plunged into ice water and almost instantly cooled, the changes would not revert themselves in the same order that they did during the slow cooling, but on the other hand, the steel would remain in practically the same condition as it was when plunged into the water. It would be frozen instantly, and the condition of transition rendered permanent.

Owing to the nature of steel in taking on certain well-defined forms at different temperatures, a series of laboratory names for these condition or arrangement of the iron-carbon crystals are in common use among metallurgists although not employed commercially. It is part of the art of heat-treating to hold the steels by different varieties of quenching and heating in these definite conditions. The highest temperature condition is Austenite. As the steel cools it breaks up into various other named forms which will be described. Different kinds of quenching and different kinds of heating enable the metallurgist to hold the steel in these definite states. The alloys also do their parts and by their use enable the metallurgist to keep the steel as near the state of Austenite which is the highest point as he desires or to bring it lower down the scale to the other points if this be what is wanted. Generally speaking the higher the steel or nearer towards Austenite the harder it is and the further away from Austenite the softer it is.

When the temperature of the steel is raised to the gamma point, the iron in it has the property of being able to take carbon into solution. This solid solution of carbon in gamma iron is known in the laboratory as Austenite. Steel in which the Austenite exists is known as Austenitic steel and under the microscope the grains of Austenite can readily be recognized by their tendency to take up regular polygonal forms. If the steel were allowed to cool below the critical gamma point the Austenite would tend to break up, since the iron



Three steps in the refinement of chrome-vanadium steel. Left—Steel in normal condition as rolled. Center—Same steel annealed at a temperature sufficiently high to recrystallize. Right—The same steel after a complete heat treatment. The transition from the coarse grains to the fine is marked.—United Steel Co.



Heat treating furnace which is used for small parts, as manufactured by the Brown & Sharpe Co.

would begin to lose its ability to hold the carbon in solid solution. The Austenite breaks up into pure iron, Ferrite and an iron carbide (Fe_3C) known as Cementite.

The change from the Austenite to the Cementite and Ferrite is not a sudden one, but there are three phases of transition each possessing structural peculiarities which determine the qualities of the resulting metal. The first stage is Martensite. This is a hard, brittle substance which on account of these qualities is of practically no use. Martensitic steels are hard and brittle. They cannot be worked and possess few if any qualities that render them fit for use.

The next stage of transition is Troostite. This is a brief stage and possesses finer crystals than the Martensite, giving the steel much better qualities. Steels having a large percentage of Troostite can be used where a great hardness is desired without a high elastic limit.

The third and final stage is Sorbite. This structure is largely composed of very finely divided mixtures of Ferrite and Cementite. It has very fine crystals and, due to this fine structure, possesses great strength and toughness. Sorbitic steels are highly desirable for work where strength and elasticity are required.

Pearlite a Definite Structure

Owing to the fact that Ferrite and Cementite have a marked tendency to inter-stratify, the structure which is formed by this inter-stratification has been given a definite name. It is called Pearlite, because, under the microscope, it has the appearance of mother of pearl in long thin streaks. Pearlitic steel is perhaps the most common of structural steels having a desirable amount of uniformity with a fair amount of strength of elasticity, due to a fairly equal distribution of the crystals.

To sum up, Austenite is the condition in which steel is found when heated to between 700 and 1,100 degrees Centigrade. As the steel cools, the next stage it passes through is Martensite, then Troostite, Sorbite and finally breaking up into Ferrite and Cementite. A certain definite mixture of Ferrite and Cementite is practically always existent, due to the carbon content of the steel, and this formation is known as Pearlite. The definitions of these terms follow:

Austenite—A solid solution of iron carbide in gamma iron.* Austenite and Cementite are found between 700 and 1,100 degrees Centigrade. On cooling Austenite splits up into Ferrite and Cementite.

Martensite—The first stage through which metal passes in changing from Austenite into Ferrite and Cementite. It is very hard because of its large content of hard, brittle iron and is generally too brittle for practical use.

Troostite—The second stage through which metal passes in changing from Austenite into Ferrite and Cementite. This and

Sorbite—the third and final stage in the change seem to be chiefly very finely divided mixtures of Ferrite and Cementite. Because of this fineness in molecular structure Sorbitic steel has a remarkable combination of strength and elasticity.

Ferrite—is iron free from carbon and forms almost the whole of a low-carbon steel.

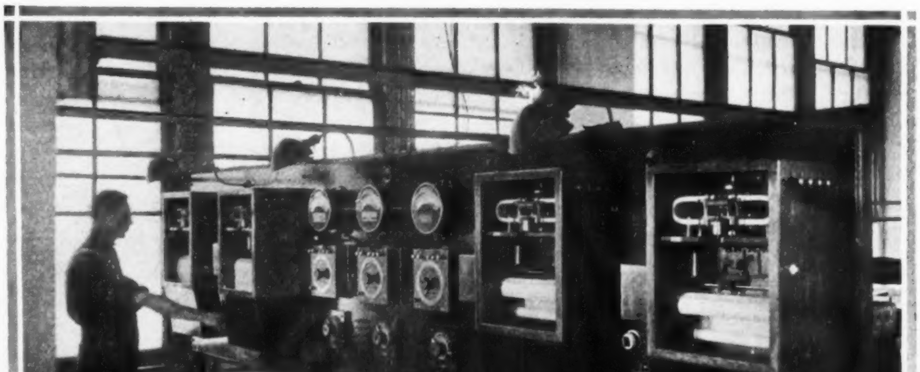
Cementite—is a definite iron carbide, Fe_3C. It is harder than glass and nearly as brittle. One per cent. of carbon in a steel implies that 15 per cent. of the soft, ductile Ferrite is replaced by glass-hard Cementite and hence the cause of the vast influence of carbon on steel.

Pearlite—is the result of inter-stratification of Ferrite and Cementite in the ratio of six parts of Ferrite to one of Cementite.

If, instead of allowing the metal to cool gradually, it is cooled quickly, or quenched, the changes which have taken place during the rise of temperature are not able to revert themselves and to a large extent the resulting material will

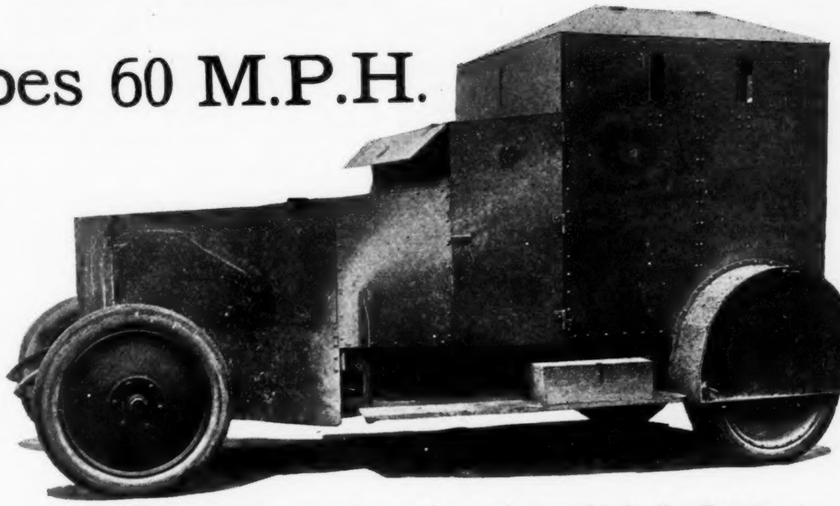
*Gamma iron is the unmagnetic form of iron found between temperatures of 770 and 900 degrees Centigrade with the carbon content below .5 per cent.

(*Continued on page* 730)



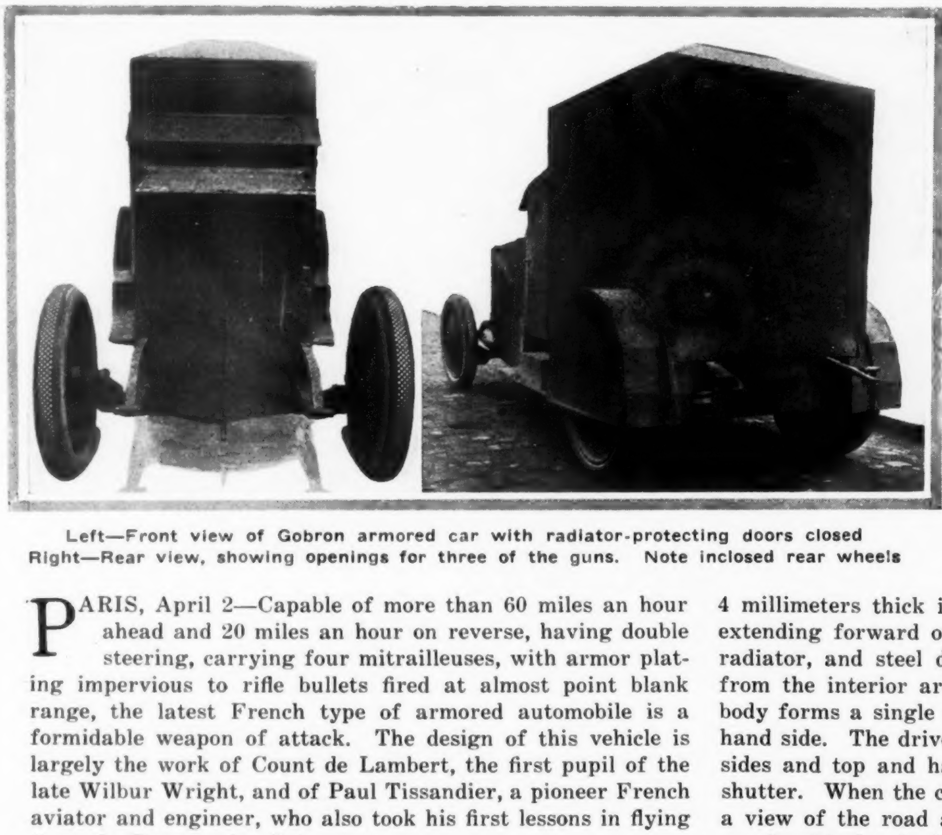
Control board of the heat treating furnaces at the Packard Motor Car Co.'s plant in Detroit

War Truck Does 60 M.P.H.



Gobron 80-horsepower armored car, the most powerful in the French army. Is capable of over 60 miles an hour and mounts four machine guns

Double-Steer, 80-Horsepower Gobron Can Also Attain 20 Miles Per Hour on Reverse—Four-Cylinder, Double-Piston Motor—Carries Four Machine Guns



Left—Front view of Gobron armored car with radiator-protecting doors closed
Right—Rear view, showing openings for three of the guns. Note inclosed rear wheels

PARIS, April 2—Capable of more than 60 miles an hour ahead and 20 miles an hour on reverse, having double steering, carrying four mitrailleuses, with armor plating impervious to rifle bullets fired at almost point blank range, the latest French type of armored automobile is a formidable weapon of attack. The design of this vehicle is largely the work of Count de Lambert, the first pupil of the late Wilbur Wright, and of Paul Tissandier, a pioneer French aviator and engineer, who also took his first lessons in flying from the Dayton air pilot.

80-Horsepower Chassis

The chassis employed is an 80-horsepower Gobron having a four-cylinder double piston motor of 4.3 by 9.8 inches bore and stroke. Although the motor differs from the standard type by reason of the use of two pistons per cylinder, there is nothing experimental in the chassis. Double piston motors have been made by the Gobron company for about 12 years and were very successful in the early racing days. The chassis has a four-speed gearbox and chain drive. Combined with the ordinary steering gear is a supplementary control of the front wheels by means of stout steel cables brought to a boat-type steering wheel in the rear of the car. The driver remains at the steering wheel at all times and always has control of the motor, but when it is necessary to go astern a second man takes the wheel at the rear of the car, obtains a view of the road through a small eye hole, and directs the course of the car while giving directions to the man behind him. Owing to the high power of the motor, which makes possible a speed of 65 miles an hour on the level, it has not been necessary to modify the gearbox, for the ordinary reverse gives a speed of 20 miles an hour.

While detail improvements might be possible in the control and reverse, practical experience has shown that this type of vehicle is thoroughly satisfactory. Nothing has to be changed on the ordinary design, and the addition of double steering does not interfere with any of the existing features of the car. This is most important when cars have to be produced under war conditions and in the shortest possible time. The chassis is of much stouter construction than those employed up to the present, but it is found that this extra strength is needed for rough work at the front.

A special steel body built of plates 4 millimeters thick is carried on the chassis, the protection extending forward over the top and sides of the motor and radiator, and steel doors capable of being opened or closed from the interior are hinged in front of the radiator. The body forms a single compartment, with entrance on the left-hand side. The driver is placed low, is completely incased on sides and top and has a forward view under a hinged steel shutter. When the car is under fire this shutter is closed and a view of the road ahead is obtained through an opening a couple of inches in diameter.

PARIS, April 2—Writing from the Argonne district of France, where he is serving as automobilist on the headquarters staff, Albert Guyot says: "At the present time the Argonne track is taking up so much of my time that I am unfortunately unable to come to Indianapolis. Please tell Messrs. Fisher, Sedwick and Beecroft that I hope to be with them next year."

Since the beginning of August Albert Guyot has been driving the commanding officer of the Fifth Army Corps. During the whole of the winter he has been stationed in the Argonne district, where fighting has been more severe than on any portion of the front.

"The automobile is rendering inappreciable service to the army. The American trucks have now arrived and are proving entirely satisfactory. Packards in particular are highly spoken of by men who are no novices in automobile matters, and I have several friends in the mechanical transport sections who tell me they have not experienced the least trouble."

Having passed the military examination second out of 110 competitors, it is probable that A. Guyot will shortly be promoted from the rank of sergeant to that of sub-lieutenant and put in charge of an automobile convoy.

European High-Efficiency Motors

Part II—Value of Compression—Relation of Gas Velocities and Intake Passage Section—Use of Two Carbureters—Valve Design for Racing

By S. Gerster

COMPRESSION should be high enough to ensure sufficiently rapid combustion at high motor speeds, but it should be kept as low as possible to guard against the danger of premature ignition. In estimating compression it is useful to employ the factor P.

Let

V = volume displaced by one piston,
V_c = volume of compression space,
P = compression factor.

Then

$$V + V_c = P \times V_c$$

Or

$$V_c = \frac{V}{P - 1}$$

For racing motors a good value for P is 5.2, and for touring car motors of high efficiency P may equal 5.

After having designed and calculated the volume of the combustion chamber, the careful engineer should make a wood model and test it in a vessel containing water. This is the best way to obtain the assurance that both the calculations and the drawings are correct.

Proportioning Gas Passages

Let us now consider the gas passages and the gas velocities. Gas velocities have a most important bearing on high-efficiency motors, and it is particularly in the valves that the designer meets with difficulties; the cause of the limitation of the motor speed is frequently to be found here.

The necessity for preserving a correct form of combustion chamber makes it impossible to adopt exaggerated valve diameters. The inertia of the valve makes it impossible to increase the lift beyond certain limits.

The expression gas velocity is really only a relative value. We understand by the expression the velocity of the gas if it had a constant flow through a given section, taking as our base the speed of the piston, and as our ratio the surface of the piston and the section through which the gas passes. When the following values are applied:

S = Surface of the piston in square centimeters; or square feet;
f = Section of the gas passages in square centimeters; or square feet;
V_g = Velocity of the gas in the section, in meters per second; or feet per second;

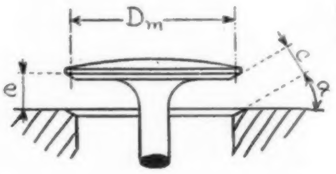


Fig. 9—Valve lift factors determining gas passage

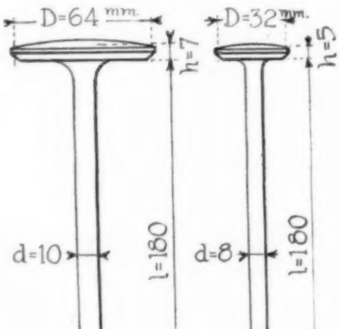


Fig. 10—Dimensions of the poppet valve as regards length of stem, diameter of head, etc.

v_p = Piston speed in meters per second; or feet per second; we obtain

$$V_g = \frac{S \times v_p}{f}$$

In the calculations for a particular motor SV_p becomes a constant. For a racing motor the gas velocity in the intake passages is

V_g = 55 to 60 meters or 180 to 196 feet per second.

We have here to deal with motors turning at 3,500 to 4,000 r.p.m., and it is obvious that if the revolutions drop to 2,000 the gas velocity in the intake pipes becomes insufficient. Gasoline condenses on the walls of the gas passages, with the result that the motor misses at low speeds and loses its flexibility.

Attention was first of all paid to the carbureter, and by reason of experiments it has been improved in a wonderful degree. Good results have been obtained by the use of two carbureters with separate intake pipes uniting near the valves. For motors with two intake valves there is a more simple solution. All the right-hand intake valves are united to one carbureter and the left-hand valves of each cylinder to the second carbureter. By this arrangement one carbureter is used for slow running and the two together for high speeds. For high efficiency motors on touring cars it is advantageous to have the two valve sections and the gas passages of different diameters. Patents have been secured for this device.

The gas velocity from the carbureter outlet to just below the valves is constant, and the section should not vary, except for six-cylinder motors where the gas passages must be designed with particular care according to principles laid down after experiments with this type of motor.

In practically all modern motors the gas velocity around the exhaust and the intake valves is

V_g = 50 to 55 meters per second (164 to 180 feet).

It is calculated in the following manner:

D_m = Average diameter of the valve;
e = Valve lift;
c = $e \sin \alpha$;
α = Angle of the valve;
n_s = Number of intake valves per cylinder.
} See Fig. 9.

The gas passage f becomes—

$$f = D_m \times \pi \times c \times n_s.$$

The velocity of the gases becomes—

$$V_g = \frac{S \times v_p}{D_m \times \pi \times c \times n_s}.$$

Formerly the valve angle was 45 degrees. In high speed motors 30 degrees is often preferred. Certain manufacturers prefer to have a rather lower gas velocity around the exhaust valves than around the intakes, and in order not to have two types of valves they make the exhaust valve cams a little higher so as to reduce the gas velocity of the exhaust 5 to 10 per cent. in relation to that of the intake.

The velocity of the exhaust gases at the ports is generally maintained at 40 to 45 meters (131 to 147 feet) per second, and the velocity in the exhaust pipes at 20 meters (65 feet) per second; this gives an exhaust pipe diameter, for a four-cylinder motor, practically equal to the cylinder diameter. These remarks refer to racing motors. For other motors, to

be used on touring cars or for aviation purposes, the gas velocity in the pipes can be made 30 to 40 meters (98 to 131 feet) per second.

We now have to deal with multiple valves—two intakes and two exhausts per cylinder, and shall have to examine the effects of inertia, so prejudicial to the satisfactory operation of these organs.

Supposing a valve of 64 millimeters (2 1-2 inches) diameter (see Fig. 10), is replaced by two valves of 32 millimeters diameter (1 1-4 inches), the gas passages, the valve lift being the same in each case. Then for the one big valve

$$f = D_m \times \pi \times c \times n_s = 6.4 \times 3.14 \times 0.8 \times 1 = 16.2 \text{ cm.}$$

The section of the gas passages of the two small valves is

$$f = D_m \times \pi \times c \times n_s = 3.2 \times 3.14 \times 0.8 \times 2 = 16.2 \text{ cm.}$$

The two sections are alike, but as we shall see the valve weights are not.

The weight, P_g of the big valve becomes

$$P_g = \left(\frac{D_m^2 \times \pi}{4} \times h + \frac{d^2 \times \pi}{4} \times l\right) \times a = \left(\frac{6.2^2 \times 3.14}{4} \times 0.7 + \frac{1^2 \times 3.14}{4} \times 18\right) \times 7.5 = 276 \text{ grammes.}$$

The weight of the two small valves becomes

$$P_g = \left(\frac{D_m^2 \times \pi}{4} \times h + \frac{d^2 \times \pi}{4} \times l\right) \times a \times 2 = \left(\frac{3.2^2 \times 3.14}{4} \times 6.5 + \frac{0.8^2 \times 3.14}{4} \times 18\right) \times 7.5 \times 2 = 196 \text{ grammes.}$$

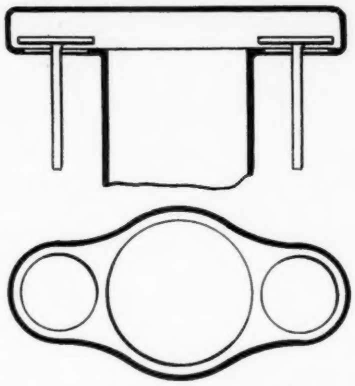
The big valve weighs 276 grammes whilst the two small ones of equal section only weigh 196 grammes. It is obvious that the two small valves are preferable. The effort required to operate them is less, while their inertia is not a very important factor.

As to the position of the two valves in the cylinder, we may turn to Figs. 11 and 12, if the valves are operated from below. Fig. 11, which represents the single valve, shows a combustion chamber spread out too much, while Fig. 12 shows a more compact combustion chamber with twin valves better disposed for high-speed work.

In overhead valve motors the difference in the shape of the combustion chamber, whether fitted with one or two valves, has a lesser importance; but the difficulties resulting from the weights exist in both cases, and we shall see later the value of adopting two intake and two exhaust valves in this case also.

Effects of Valve Weight

Let us now examine the efforts exerted on the valves and their operating gear, due to the inertia of the moving parts. Fig. 13 shows the shape of a cam operating a valve weighing 98 grammes, fitted with a valve spring collar of 20 grammes, and operated by a tappet weighing 55 grammes. It is now



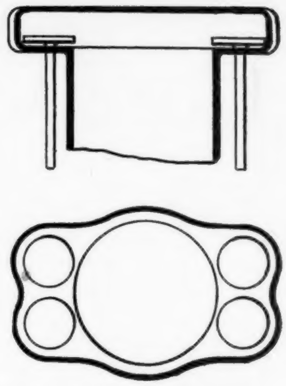


Fig. 11—Single valve with widely spread out combustion space
Fig. 12—Double valves showing more compact combustion space

necessary to discover the effort required to move a valve, in order to be able to calculate the dimensions of the camshaft. In the design of each motor it is necessary to examine in this way the cams and the other moving parts, as shown in the following example.

The cam shown in Fig. 13 is an admission cam revolving at 2,000 revolutions per minute. The line b — b is the track of the roller around the cam. The diagram shown in Fig. 14 is the development of the lifts in abscissae, and of the angles in ordinates. The line a — a is only the development of the distance covered by the axis of the roller. The line c — c is the tangent of the greatest inclination or the line of the greatest velocity of lift of the cam; with these indications it is easy to find the effort necessary to move the valve with its pushrod. Thus; if

P = Effort on the cam at the moment of the greatest lift of the valve.

P_s = Weight of the valve spring.

P_p = Weight of the tappet spring.

P_{is} = Effort of inertia of the valve.

P_{ip} = Effort of inertia of the pushrod.

we obtain

$$P = P_s + P_p + P_{is} + P_{ip}$$

P_{is} becomes equal to the mass of the valve M_s multiplied by its greatest acceleration j or

$$P_{is} = M_s \times j.$$

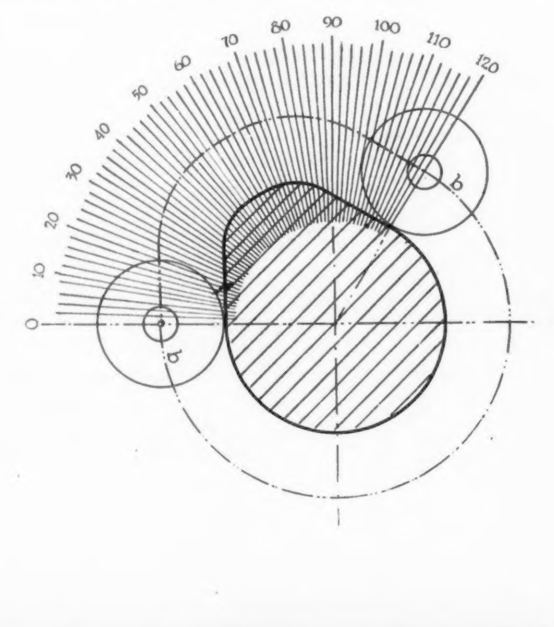
The mass M_s is equal to the weight of the valve and of its valve spring collar divided by g, or

$$M_s = \frac{0.098 + 0.020}{9.81} = 0.0119 \dagger$$

The maximum acceleration j becomes, if v_c is the velocity

†NOTE—In the following examples the metric values have not been converted because they serve equally as well as American standards to show the effect desired. This calculation is in the nature of a proof rather than a working task.

(*Continued on page 729*)



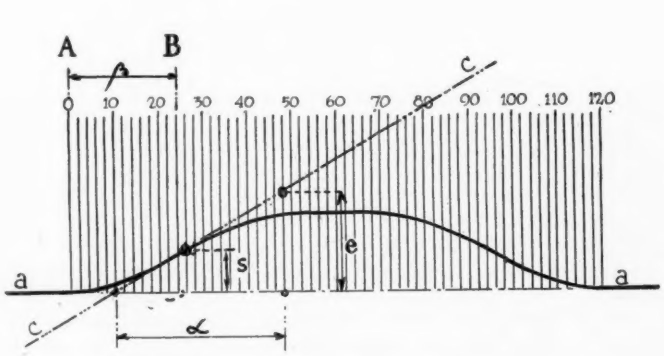


Fig. 13—Left—Cam shape for valve weighing 98 grammes

Fig. 14—Right—Diagram of valve lifts and angles

Chain Camshaft Drives Bound to Come

Pros and Cons of Roller and Silent Type Chains—Adjustment Advisable

By A. Ludlow Clayden

THAT the chain for camshaft driving came to be taken up so quickly in Europe was due mainly to the acumen of one English chain maker who, having had the order for chains for Knight motors forced upon him, had the foresight to see therein the nucleus of a great business. It is undoubted that the advent of the chain in motor construction was due to Chas. Y. Knight, who refused to use gears in his English Daimler motors, because their liability to hum or sing destroyed the quiet action of the Knight sleeve valves. Thus Europe owes the chain-driven camshaft, with which she is well satisfied, to the instigation of an American inventor.

When the chain was first put out as an essential feature of the Knight motor all sorts of dire predictions of early failure were made. Again, when the chain had proved its worth for driving sleeve valves, it was said that the more jerky action of a camshaft for poppet valves would destroy the chain even if it did stand up in the Knight motor. Again, it was the optimists that were proved correct. But let this not be taken as meaning that there were no troubles, for there were plenty in the early days and are still some now. Firstly, it was discovered that the chain had to be large. Practically it could not be too wide for the job, and it was price that fixed the limit. Next it was soon found that a great deal depended upon the exact tension with which the chain was mounted in the first instance and that it was advisable not to let the chain become too slack; otherwise fracture was not improbable.

Adjustment or No Adjustment?

This much-vexed question remains still to be settled, and it is not too easy to discuss it without showing personal prejudice. The writer has run a chain without adjustment in a small high-speed motor for a distance corresponding to at the lowest possible estimate 60,000,000 revolutions, probably 100,000,000 is really more nearly true. At the end of this time there was no appreciable slack in the chain. To save the trouble of conversion it may be added that this represents 15,000 miles running of a little car with small wheels, much of the time being spent in mountainous districts with a great deal of low-speed climbing. Still the writer, despite this experience, is inclined to prefer adjustment, because it allows the chain to be set correctly before the car leaves the factory.

In England the largest manufacturer of automobiles is the Wolseley company, which makes a high-class car at the rate of something under 5,000 per year. After experiment they decided to use no adjustment, but instead to subject each chain to a run. Chains are measured carefully and all those over a certain length are rejected. The remainder are run under load for lengths of time which vary for each chain, the run being continued till a certain length is reached by stretching. This is costly, but thought to be cheaper than an adjustment as part of the motor, while it also removes the danger of some unlearned owner tightening up the chain too much and so stressing not only the chain itself, but the camshaft and the bearings.

The purpose of adjustment is to provide the correct tension; the use of the tension is to keep the slack side of the chain—the side not pulling—from fluttering or swinging. If the loose side of the chain is free to swing the driven sprocket will have backlash and it will be possible for the chain to move freely against no load and then be brought up with a bump at the end of the slack. This means that the inertia of the parts driven can subject the chain to very heavy blow-like stresses.

Slight Slack Shortens Chain Life

One might easily think that this sort of action could not take place until the chain had become quite slack, but this is not true; a very small degree of slack will suffice to shorten the life of the chain a great deal. Yet all that we have to do is to prevent the side which is not loaded from jumping about.

So far the writer has been considering only the so-called silent chain, but the roller chain has been used also for camshaft driving, and with good success. It is much cheaper than the silent chain, it is almost as durable—some say more durable—and it is not perceptibly less quiet in operation if the sprockets are well cut and the lubrication is copious. The outstanding advantage of a roller chain is that it can be bent both ways, it can have one side in mesh with one sprocket, and the other side with the next, which means that, if we have a slack roller chain connecting the crankshaft and camshaft, we can put a jockey sprocket behind the slack side, and maintain the tension with a spring. It is not essential to use a sprocket for this purpose as a plain pulley with a smooth surface will do if its bearings are so free that there is no possibility of it seizing and letting the chain "skid" over it instead of turning it. Two European makers of large quantities of automobiles have used this system, Belsize in England with the plain pulley idea, and Mathis in Alsace-Lorraine, with the jockey sprocket. Both have been most successful and among the 1915 models of European touring cars that were passing out of experimental departments last June, there were several imitators.*

High Speeds Make Gears Noisy

One maker with whom the writer was in close touch, found some trouble in obtaining the desired degree of quietness, but the noisiest of roller chains is less noisy than the quietest of spur gears. Remember, it is the high revolution speeds of 2,000 and over that are now common in Europe which have made the distributing gear noise an acute manufacturing question. Racing cars like the Peugeot and Mercedes have the best-made gears obtainable, but the scream of the pinions when the motors are running fast can be heard for half a mile away quite easily.

With a silent chain it is possible to put a plain pulley against the back of the slack side, but it has been done only quite rarely, just why this is so not being obvious, but for quantity production the roller is a much more attractive

*The 1915 models in Europe would not have been announced till last November following practice over there, which is regular.

proposition than the silent pattern. It is cheaper, it is probably stronger for its weight—especially when worn a bit; it is easier to assemble and it is easier to provide with adjustment of a simple character. Against these advantages there can only be put the still greater quietness of the silent kind. In fairness, it should be added that some chain makers claim that the silent chain is the more durable—weight for weight—and there is little evidence to show whether this is, or is not, the case.

Designing Advantages of Adjustment

The engineer gains from the provision of adjustment, whether automatic or not, the advantage that he is not bound to minutely exact centers for the camshaft and crankshaft; these can be arranged a convenient round number dimension apart and the adjustment left to care for the slack. The manufacturer gains the ability to use all the chains without rejects, as he can adjust either short or long chains to give equally good service. When one remembers the immense number of joints in a chain—and every joint is a bearing—it is obvious that it is fairly close work when guarantees are demanded that the variation of each foot of chain shall not exceed a few thousandths of an inch.

Yet engineers in Europe have fought against the adjustable feature, because it taxes their ingenuity to accommodate a simple, inexpensive and yet thoroughly effective device. Still it can be done, as there are plenty of examples to show; the chain makers are a mine of ready reference on this branch of the subject, and one cannot avoid the feeling that the automatic adjustment will win out.

Possibility of Special Gearing

There have been several attempts to find an application of worm or spiral gearing which would be as quiet as the chain and more durable. Experiments along this line in Europe have not been very persistent nor have they been very encouraging, but a few are now being made here. Anyone who would venture to forecast the result would be distinctly bold, but there seems no doubt but that the helical spur gear is bound to vanish, with the common use of higher motor speeds, upon which most engineers seem agreed. It is to be hoped that the special kinds of spiral gearing will gain adherents, because that is the only way in which the matter can be settled, but meanwhile there is no need to be afraid of the chain as long as it is good chain. It will cost more than cast iron helical gears, but then so does the self-starter automobile cost more than the cranked one. Like all other things that really do make for the comfort and pleasure of the motorist, quiet motor distribution gearing is bound to come.

Details of Design

Chain makers agree that the best form of chain layout for the average motor is a triangular arrangement, the chain passing round the crankshaft and camshaft sprockets and also round a third sprocket which drives the magneto, pump or generator. The latter fitting can usually be so arranged that adjustment of the chain is possible. Yet when one actually gets busy on the drafting board to put such a chain into an average motor it exhibits surprising difficulties. It is not advisable to use a layout that causes the chain to embrace only a small arc of any sprocket—on the contrary, it ought to wrap round as much of the sprocket's periphery as possible. It is particularly inadvisable that the crankshaft sprocket which does all the driving, should only touch three or four teeth of the chain. In the usual motor it will be found that the camshaft and crankshaft centers lie in such positions that the third pinion for a triangular drive has to be situated in a position where it is useless for driving anything else. It would not be possible to use a single chain to drive two camshafts in a T head motor, for example.

None the less, it is the business of the chain concerns and the automobile engineers to find some easy way in which one chain, with adjustment, can be made to serve for driving the camshaft and the generator or other auxiliary. The use of more than one chain cannot be *necessary* and it must inevitably lead to increased cost. Again, to use chain for one part of the distribution gearing, and spur gears for another part, is to throw away the advantage of the chain altogether.

Any engineer who enjoys a mechanical problem will find the question of chain layout a most fascinating exercise for his faculties, but those who decide to try it should remember that there are two kinds of chain, and that the roller pattern has not yet been given many opportunities to show its qualities in motor work, although it is peculiarly attractive by reason of its ability to drive on both sides at once.

—

Skilled Mechanics in Demand for Detroit Car Factories

DETROIT, MICH., April 17—There is hardly an automobile or motor car parts manufacturing concern in the city today which is not trying to add to its working force. Small concerns with less than 100 men on their pay-rolls and big plants with thousands of men, with even day and night shifts, are either advertising directly, or indirectly through the medium of employment agencies, for more men.

Although a similar condition exists practically every year at this time, this year the demand for skilled workingmen is much greater than ever before. By skilled men the manufacturers mean specialists for special machines and expert mechanics.

At the plant of the Maxwell Motor Co., where 2,000 to 3,000 men are now employed, it was said that there is room for an unlimited number of skilled mechanics. The Cadillac Motor Car Co., although having now more than 8,200 men on its pay-roll, is lacking from 100 to 150 specialists not assemblers or body painters or trimmers, but men who can handle the special machines. Ford, with over 16,000 men working, is also looking for the skilled worker. So it is with Packard, Regal, Paige, Chalmers, King and many others.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TEN TESTERS,
Body, hood, windshield and top fitters for final assembly work; none but experienced men with tools need apply; best wages.
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AUTOMOBILE body framers and cleaners on Ford bodies wanted. Herbert Mfg. Co., Kirby and Vermont.

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A1 sheet metal finishers on bodies, wood working machine hands on saw tenenor, band saw, planer, jointer, mitre saw and shaper machines, and diemakers. Apply Employment Office, St. Antoine and Piquette.

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BEARING SCRAPERS
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MILLWRIGHTS
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NONE BUT EXPERIENCED MEN WITH TOOLS NEED APPLY
Maxwell Motor Co., Inc.
Oakland Ave. Plant

ATTENTION MECHANICS
We have openings for first-class men in the following, and other trades:
Tool and diemakers
Toolroom machine hands
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All around machinists
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Hand and automatic screw machine operators and setters
First-class inspectors
Acetylene welders
Millwrights
Motor, final and rear axle assemblers
Service and motor repairmen
Bearing scrapers
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Power sewing machine operators
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NO FEE CHARGED
EMPLOYERS' ASSOCIATION OF DETROIT
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MACHINE REPAIRMAN,
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Newspaper advertisements of Detroit car and parts factories for more men

The Engineers' Forum

Defense of Front Position for Radiator—Front Radiator Lighter—Less Interference with Other Parts—Overhead Valve Motor Need Not Be Costly

By Russell Huff,

Consulting Engineer, Packard Motor Car Co.

DETROIT, MICH., Editor THE AUTOMOBILE:—The advantages of the conventional way of placing the radiator out in front of the motor on passenger cars and trucks, instead of behind the motor, are so numerous and obvious that there can be little argument of real merit left for any other construction.

In almost every problem of engineering there are several ways of accomplishing the desired result, but the best compromise construction is usually adopted. It is seldom the ideal is realized in any engineering problem. The radiator in front of the motor may not be the "ideal" construction, but a study of the problem by automobile engineers in this country and abroad for 20 years has led them to adopt this construction as the best compromise, and it has become the standard conventional construction of the world.

Front Radiator Is Lighter

The chief criticism of this construction is that the radiator in this position is more exposed to danger from traffic accidents than is the case with the radiator placed behind the motor. To offset this one criticism there are a number of pertinent reasons favoring this construction.

The radiator located in front has by far the greatest cooling efficiency, when size and weight are taken into consideration. It can be made lighter than would be possible when located in any other position. This means less volume of water carried in the radiator and an additional saving in water weight. It is much more accessible, and being more compact, is less troublesome to mount in a flexible manner and has less trouble from leaks caused by frame twisting and vibration. This position also permits of a better fan mounting, which not only increases the air circulation through the radiator but also forces a draught of air back over the motor and over the exhaust header and helps to keep the engine cool. This position for the radiator also enables the artist to obtain better streamline effects in body designing.

To further offset the slight advantage of greater safety in traffic collisions which is claimed for the radiator placed behind the motor, we have the following serious objections to contend with in this construction:

Dashboard Radiator in Way of Other Parts

There is a great increase in the weight added to the car, because the radiator must be larger and heavier. This construction places the dash back farther and makes a longer wheelbase necessary. The increase of concentrated dead weight directly over the flywheel requires a heavier and stiffer frame construction to meet the new loaded conditions The longer wheelbase also calls for a stronger and heavier frame. There is also the increased structural difficulty of mounting the radiator in this position to avoid the flywheel casing, the steering gear, the control rods to the magneto, carbureter and throttle valve, and electrical wiring and piping which must connect the motor with the driver's compartment. There is great difficulty in obtaining a suitable flexible mounting for a radiator in this position, and great expense involved in removing such a radiator from the car for repairs. Inaccessibility of the radiator filling cap, increased heat in the driver's compartment in the summer time, and the difficult problem of providing satisfactory fan construction for the forced draught which is necessary to obtain efficient cooling, are additional objections to this location.

Protection a Minor Consideration

While there are a number of other serious difficulties to be overcome in securing satisfactory results from the radiator behind the motor, I believe the above-mentioned advantages of the conventional construction where the radiator is placed out in front of the motor, and the disadvantages of locating the radiator behind the motor, more than offset the one single advantage of greater protection from traffic accidents which is claimed for the latter construction.

Even in the danger zone in war times, the radiator in front is a safer type to use, because it presents a smaller target for the enemy than the large, bulky radiator placed behind the motor.

The radiator in front has the still further advantage of being farther removed from the driver, so that there is less danger of bullets intended for the driver striking and puncturing the radiator than would be the case with the radiator back of the motor and close to the driver.—Russell Huff, consulting engineer, Packard Motor Car Co.

Front of the Car Is Best Position for the Radiator

By John Younger

BUFFALO, N. Y.—Editor THE AUTOMOBILE:—On reading Mr. Morrison's letter in the Forum for April 15, I have looked up records on the reports of radiators and find that it is about 4 months since we have had one returned for trouble due to an accident wherein the radiator was punctured. These records cover the worst seasons of the year when the streets are icy and trucks are more inclined to skid than at other times.

The only thing that may be said in respect to Mr. Morrison's letter is that *something* must be placed in front of the truck, and whatever it is must bear the brunt of the collision affecting this part. If it is only a thin sheet steel hood over the engine, it is as likely to be punctured, and the obstacle will be driven in on the motor.

Our company mounts the radiators somewhat back of the very front of the truck, with a large, stout bumper in front, which protects the vital parts from the majority of collisions.

We have found that when you have arranged for your exhaust pipe and flywheel, and other parts of the motor, to go through the radiator, then the advantage of accessibility is sacrificed very materially, so, taking everything into consideration, we prefer the radiator in its present position.

In so much as radiators have been placed on cars behind the motor for many years, yet the majority of cars and trucks are still fitted with radiators placed in the front, it is obvious that there is no advantage in making any change in position.—JOHN YOUNGER, chief engineer, truck department, Pierce-Arrow Motor Car Co.

Overhead Valve Cheaper to Manufacture than Pocket Type

NEW YORK CITY—Editor THE AUTOMOBILE:—Having recently read the interesting article on overhead valve motors by A. Ludlow Clayden in THE AUTOMOBILE, for April 8, I would like to state that the idea that expense is involved by using overhead valves is not always true. In elaborate motors like the racing Peugeot the cost of the valve gear may be very high, but in commercial manufacturing much simpler designs give good service. Motors like the ones not so popular for small cars have detachable heads with the valve seats machined directly in the heads. After facing off the head it is a cheap job to cut the seatings and bore the valve guides—cheaper than it is on a block casting without a detachable head. The cost of the rockers and the long push rods is very small and is offset by the simpler cylinder castings and the fact that no valve cover plate is needed. In a good many overhead valve motors the valves are shorter and the springs lighter than are needed for the pocket type and this saves money as well.

Suitable for Eights

I agree with Mr. Clayden as to the suitability of the overhead type for eights. We already have one example of the neatness that can be gotten this way in the Ferro, which is the neatest of all the eights to look at. It is very surprising that there have not been some more attempts along this line, and I shall expect to see a lot of overhead valve eights next year.

A theoretical point in favor of the valve-in-head that seems to me to have been missed is that it is much easier to make the gas passages inside the casting for this type. There is no need to have the intake and the exhaust so much mixed up with each other when the valve ports are not all in a row, side by side.

I think it is easier to make a cheap motor to give good power with overhead valves than with ordinary valve location, or else why do so many manufacturers adopt the system for their small motors? R. P. M.

Recent Court Decisions—Some Insurance Cases

By George F. Kaiser

AS almost without exception, every automobile owner, whether an owner of a passenger car, or a commercial vehicle, is insured under policies covering him against loss by fire, theft, liability or collision, the question of insurance is an important one. Several court decisions have been lately handed down on the question of insurance.

In New York it has been decided that, when a policy provides that it shall be void if the person insured conceals or misrepresents any material facts concerning the subject of the insurance, that the person's statement embodied in the policy that his automobile is a 40-horsepower four-cylinder touring car, built in 1910, when, in fact, it is a 24-horsepower car developing only 29-horsepower and built in 1906, is a misrepresentation of a material fact as mentioned above and therefore voids the policy.—*Read vs. St. Paul Fire & Marine Insurance Co.*, 151 *N. Y. S.* 274.

In this case an action was brought to recover $500 on a policy upon an automobile, which was destroyed by fire. The court held that if a company is informed that a car is a 1910 model, when it is a 1906 model, they are relieved from payment of loss under the policy, as a 1910 car is naturally of a greater value than a 1906 car.

A Theft Insurance Case

In another New York case where a policy had been issued insuring an automobile against loss by theft, the court held that the person insured must show that the car was stolen and taken with a felonious intent, and that he could not recover under his policy if he had been wrongfully deprived of it by one acting under an honest belief that he was entitled to its possession.

Suit was brought to recover $1,000 on a policy against loss, theft, robbery or pilferage. The owner of the car sailed for Europe, leaving the car in his country place in Connecticut. A short time thereafter a man went to the place where the car was kept and told his caretaker that he was the owner's partner and he was taking the car down to have it painted and would return it in ten days. The caretaker turned the car over and a receipt was given for it. The party taking the car was under the belief that he was entitled to it, because it was the property of a company of which he was a member.

The court held that the car owner could not recover from the insurance company on this state of facts, as the automobile had been taken by mistake and not with an intent to steal it.—*Rush vs. Boston Insurance Co.*, 150 *N. Y. S. (New York) 457.*

When the Car Is Rented

In still another case the court held that in a policy which insured the owner of an automobile truck against loss arising by reason of its ownership, maintenance or use, a warranty that "none of the automobiles herein described are rented to others" spoke of as of the date of the policy, and hence was not violated because thereafter and at the time of the accident on which the assured brought suit it was rented to others.

Suit was brought against the automobile truck owner for damages resulting from injuries received by being struck by the truck.

The court held that, although there was a warranty in the policy that none of the automobiles were rented to others, that warranty only applied to the date of the issuance of the policy, April 14, 1912, and not to the date of the accident, May 24, 1914, and therefore the truck owner was entitled to judgment against the insurance company.—*Mayor Lane & Co. vs. Commercial Casualty Insurance Co.*, *150 N. Y. S. 624.*

The Rostrum

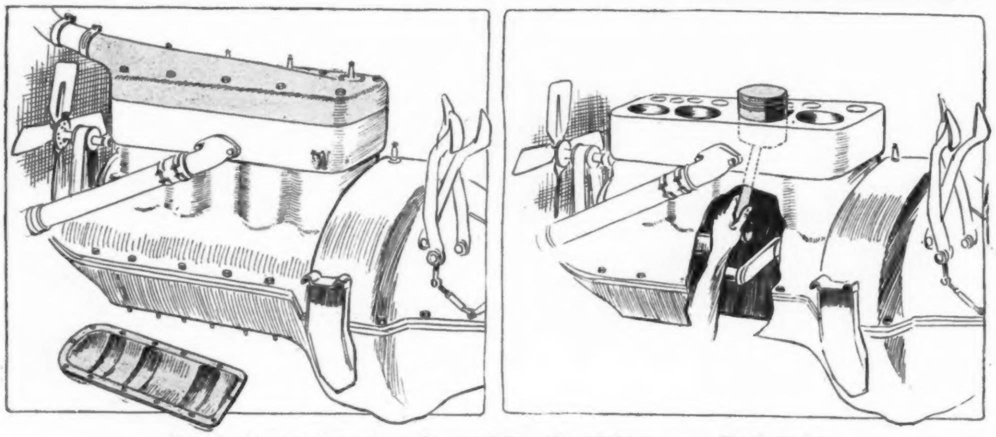


Fig. 1—Illustrating steps in reaching the pistons on a Ford motor

Side Play Caused Knock

Editor THE AUTOMOBILE:—I have a six-cylinder car of a well-known make and have used it 2 years. The last year I noticed a slight click in the engine and thought perhaps one of the push rods needed adjustment. I went all over them and adjusted them all so that there was no more than 1-32-inch play between any of them, but there was still the same click. Good repairmen tell me, when listening to it, that one of the push rods needs adjusting, but they cannot find the one that needs the adjustment. I was puzzled and when I overhauled the engine I discovered that one of the bushings, where the push rods run in, had side play which caused a knock or click similar to that when the push rods have too much play.

Johnstown, Pa. H. C.

Unused Storage Battery Should Have Care

EDITOR THE AUTOMOBILE:—The other day I started to operate my car after having had it set away in the garage for 4 months; during which time the battery ran down. I drove it 10 miles to a well-known storage battery service station. The man in charge of this station told me to just disconnect the wiring from the charging dynamo and that it would do no harm to the electrical end to go ahead and run the car without having a battery in it to take care of the current, saying that if I had no battery to receive the current it could not generate any. Later on I met another man who said that I should not run my car a mile without a battery in it, because by so doing, I would burn the wiring out of the dynamo, because I was generating current and that without the battery there to receive it, would put my electrical apparatus all out of commission. I may say that my car is equipped with the Disco starting and lighting system.

Please advise me through the Rostrum which of the above opinions is correct.

Pleasantville, O. H. F. Y.

—In the first place you were entirely wrong in leaving the battery in the car for a period of 4 months, during which time the battery was allowed to run down. The battery should have been given an extra charging at occasional intervals in order to keep the specific gravity up to the standard, which is between 1.275 and 1.300. In laying up the storage battery for the winter, it must be remembered that the storage battery as used for electric starting and lighting or for electric lighting only, is strictly an electro-chemical apparatus, and requires a certain amount of attention or care, whether idle or in actual service. Therefore, if the car owner will bear this in mind, and follow the directions given herein, he should have little difficulty in keeping the battery in healthy condition during the winter months. If the battery is always filled to the proper height, and kept fully charged within the limits of the standard 1.280 to 1.295, it may be safely considered as being in a healthy condition. Every car owner should have a hydrometer syringe, to use in determining when the battery is fully charged, and it will also be found convenient to use in filling the battery with water.

Inspect the battery once every 2 weeks, and take a gravity reading of the electrolyte with the hydrometer syringe, to determine the strength or capacity of all cells, after which fill each cell to the level of the inside cover with pure distilled or clean rain water. If convenient for the car owner to operate the motor of his car, he should run the engine for a period of 2 or 3 hours, as necessary, until the gravity has reached 1.280 in all cells. The engine should be operated at a speed equivalent to a car speed of 15 to 18 miles per hour.

The car owner may find it impossible to charge the battery on the car on account of the necessity of placing the car in storage. In this event, if alternating current is available, a small vibrating rectifier can be purchased. This apparatus costs little, and can be attached to the wall, and connected to any standard lamp socket. Charging the battery overnight, or about 12 hours every 2 weeks, would be sufficient to keep the battery in healthy condition. This, however, must be proven by hydrometer test. If the car owner does not wish to incur the expense of a rectifier, he may remove the battery from the car, and take it to a battery service station, or garage, that has charging facilities and have it recharged every 2 weeks. The battery should be kept in a dry place.

The car owner must also bear in mind that a battery starts to wear out commencing with the day it is made. If he does not wish to be bothered with the care of the battery while his car is out of commission, he may send the battery to the nearest battery service station where it can be treated for dry storage, providing it is in healthy condition when it is sent. Under these circumstances, there would be practically no deterioration of the battery while in storage. When the car owner desires the battery placed in commission again, he should notify the service station 2 weeks in advance of the time it is wanted, in order to give sufficient time to rebuild the battery. The expense to the car owner in this instance would be transportation both ways, and the cost for tearing down and rebuilding the battery.

The car owner will, by following these suggestions, be assured that his battery will be in a condition to give satisfactory service, when placing his car in commission, after the winter months. He may also be sure that the battery cannot possibly freeze. The accompanying table shows at what

temperature the electrolyte in a storage battery will freeze.

The car owner who keeps his car in commission during the winter months will continue to give it the same care that it demands at all times of the year, but will have to give special attention to keeping it fully charged, as the work the battery is called upon to give in cold weather is unusually heavy, for the reason that a cold motor is very hard to start, therefore using more current in the effort.

2—The Disco system should always have one generator brush pulled out of the brush holder when the battery is not connected. When the brushes make contact on the commutator there is a field current generated which will rise to approximately 30 or 40 volts. This will have a tendency to heat the field coils if run in this condition for any length of time. Also if the battery is not connected and you use the generator the life will be burned out, as all the current generated by the generator will be forced through the lamps.

Freezing Point

Specific gravity 1.120 battery empty, 20° above zero.
Specific gravity 1.160 battery ¾ discharged, at zero.
Specific gravity 1.210 battery ½ discharged, at 20° below zero.
Specific gravity 1.260 battery ¼ discharged, at 60° below zero.
Specific gravity 1.280 battery full, 70° below zero.

Battery Should Float on Line

Editor THE AUTOMOBILE:—I recently attached a generator to the flywheel of a model G, 1910 Franklin, for the purpose of electrically lighting my headlights and tail light. The wiring is in series. The generator is a 3-magnet type, 6 volts and made by the Manhattan Electric Supply Co.

Owing to the unequal illumination at different speeds of the motor, I am contemplating the addition of a Witherbee 6-60 to 70 storage battery.

1—Will you kindly show by diagram the new wiring arrangement to connect the batteries?

2—Please state the voltage and candlepower of the bulbs, meaning head and tail lights. Which will be conducive to maximum efficiency?

I am using at present 6 volts and 6 candlepower for headlights and 6 volts and 10 candlepower for tail light with the result that the headlight which is on the same side as the tail light, the left, is much dimmer than its fellow at all motor speeds.

3—Please mention a good brief text book on the care of a storage battery.

Pearl River, N. Y. S. H. M. D.

—The best way to connect the battery would be simply to have it what is popularly known as floating on the line. This method of wiring is shown in Fig. 2.

2—The headlights should be 16-candlepower, side lights, 4-candlepower, and tail and speedometer lights, 2-candlepower, all rated at 6 volts.

3—The best books on the care of storage batteries are those which are published by the storage battery companies themselves. These are instruction books which give practical information on their care which is probably what you desire rather than books on the construction.

Loose Ring Causes Carbon

Editor THE AUTOMOBILE:—Cylinder number one on my Ford carbonizes very badly. The spark plug in that cylinder is shortened with carbon every time the car is run about 20 miles. I took the cylinder-head off and found that the exhaust valve had a notch burned out across the seat of the stem. I then thought that, if possible, I would put a new valve stem in and grind it well and that everything would be all right, but after I had done so an excessive amount of carbon still collected in that cylinder. I cannot understand why this is, unless it is caused by a lack of compression. That cylinder seems to miss until the engine warms up but after it is warmed up it seems to have very nearly as much power as the others. I am now of the opinion that it is losing compression past the piston rings. It may be that one of the rings is broken or sprung. The other cylinders do not carbonize like this. I know this cylinder is not losing compression through the valves because they are ground and in good condition.

Will you please advise me what you think is the trouble? What is the best way to get to the piston in order to put new rings on same? Is it best to unscrew nuts at the bottom of connecting-rod and then take the cap off, take off the piston head and then push the piston out through the top of the cylinder, or would it be best to unscrew the nuts and take off the cylinder block? If this should be done, how would I disassemble it? What nuts, etc., would I have to loosen? What should the clearance in the opening of the piston rings be after being placed into cylinder?

Plantersville, Miss. WM. I. SHUMPERT.

—The method of getting at the piston on a Ford car is to take off the cylinder head, remove the plate from the bottom of the crankcase and, by reaching through this, remove the bolts holding the connecting-rod bearings in place. After the connecting-rod bearing caps are removed, the pistons can be pushed up through the top of the cylinder. You need not bother about the clearance between the opening of the piston rings, as this will take care of itself with new rings. The method of removing the piston is clearly illustrated in the sketches, Fig. 1. The loose rings are probably the cause of your trouble.

Many Special Starting and Lighting Systems

Editor THE AUTOMOBILE:—Who makes the Auto-Lite system?

2—How many of the builders of cars own their own starting and lighting systems?

Nevada, Ia. C. W. H.

—The Auto-Lite system is made by the Electric Auto Light Co., Toledo, O.

2—None of the car builders except the Kissel company are using their own cranking system, although many have special designs which have been made by the starting and lighting company to meet the needs of the individual car to which they are fitted.

Wants Parts for 1912 Model Ohio

Editor THE AUTOMOBILE:—Please let me know where parts can be secured for the 1912 Ohio car formerly manufactured by the Ohio Motor Car Co.

St. Bernard, O. E. L. K.

—Parts for the Ohio car can be obtained from the Crescent Motor Co., Cincinnati, O.

Relation of Magneto and Plug Points

Editor THE AUTOMOBILE:—I have a four-cylinder motor equipped with a single magneto system. I have had quite a little trouble with the motor missing, both at high and low

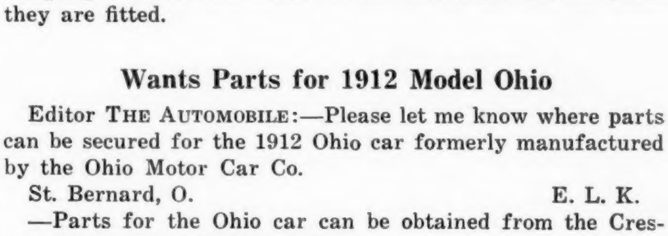


Fig. 2—Wiring diagram for a battery floating on the line

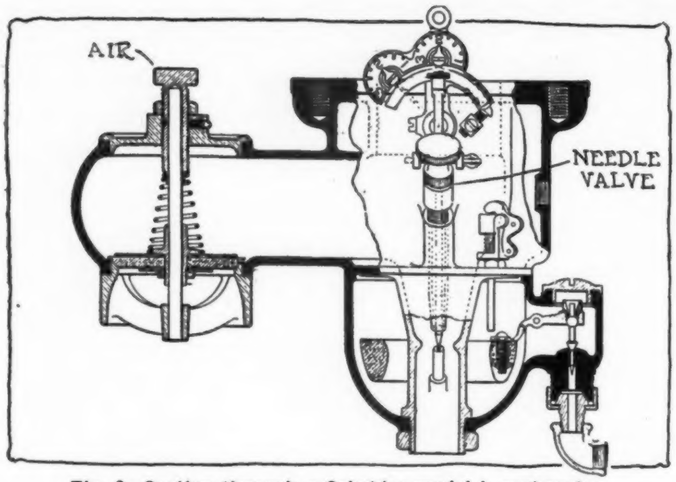


Fig. 3—Section through a Schebler model L carbureter

speeds. In going over the ignition system carefully I found that the magneto breaker box platinum points break about .015-inch on one side of breaker box and about .018-inch on the other side. I also found that by adjusting the points of my spark plugs in numbers one and four cylinders to about .020-inch apart and adjusting numbers two and three to .030-inch that the motor would run perfectly, both at high and low speed. But I was surprised to find that by exchanging the plugs from numbers one and four to numbers two and three cylinders that the motor would not run at any speed without missing. I have tried different adjustments of the magneto points, but always find that better results can be obtained by adjusting the spark plug points accordingly. I am an automobile mechanic with 14 years' experience, but this is something new to me.

I would like to be informed if there is a relationship existing between the adjustment of the magneto points and the adjustment of the spark plug points. In other words, if the magneto has a slightly different break on cylinders one and four than the break on two and three, can this trouble be overcome by adjusting the spark plug points to suit?

St. Petersburg, Fla. C. E. McNabb.

—There is no doubt a definite relationship between the two distances because of the ability of the current to jump a gap of just a certain distance. These air gaps are resistances in a circuit and hence in overcoming the resistance, the current does a definite amount of work. Naturally if a large proportion of this work is done at one point, a smaller portion will be done at the next. This would seem to bear directly on your problem, and establish the relationship which you have discovered in adjusting the spark plug points. It would seem better to adjust all the spark plug points to the minimum size opening at which they will fire in all cylinders, for in this way the uncertainty and trouble which is apt to occur should the plugs be mixed in cleaning, for instance, will be overcome.

Suggests Cause of Trouble in Starting

Editor The Automobile:—In The Automobile for March 18 M. P. B. of Lakeport, N. H., has trouble with starting his Ford when hot. My diagnosis would be that it is caused by a rich mixture as this is quite common in new cars especially in summer.

I am assuming that the car when cranked immediately after being stopped while warm will start without spinning, but upon being left standing a few moments part of the gasoline in the carbureter vaporizes and fills the intake pipe with a mixture that is too rich to be exploded and consequently must be cranked through the engine. It is seldom necessary, but in extreme cases a small petcock screwed into the intake near the place it forks and this opened while cranking the car while warm, will remedy the trouble. Would be glad to know the result.

Natoma, Kan. R. A. McEwen.

Motorcycle Engine Light for Stationary Work

Editor The Automobile:—Our company is manufacturing a labor-saving machine in which we had intended installing a 1-4-horsepower electric motor. In order to get away from the troublesome feed coil which would be constantly under foot, I want your valued suggestions on the following points.

1—Could a small gasoline motorcycle engine be used? Relatively, how much noisier would it be than an electrically-driven motor of 1-4 horsepower?

2—What would a motorcycle equipment weigh, omitting gasoline, and what space would such equipment occupy, not including gasoline tank?

3—Have you any data as to the makers of such small gas engines producing not over 1 horsepower and the probable cost of equipments in lots of 100 to 1,000.

New York City. M. A. Morris.

—A small gasoline engine can be used but it would not be advisable to use a motorcycle engine for this purpose where the motor will probably be driven under load continuously. The ideal type of motor for your purpose will be a small two-cycle marine or stationary type of gasoline engine. This is fitted with a heavy flywheel and is so arranged that it can be bolted to a firm base and thus render very simple the installation, which would not be the case with a motorcycle motor which is designed for lightness and not for heavy-duty work.

2—The motorcycle equipment would weigh much less than the marine equipment, but if you are intending this for stationary work, the mere fact of a slight additional weight would not seem to be of material difference. The motorcycle equipment would probably weigh 60 or 75 pounds, whereas the marine motor would probably weigh about 100 pounds.

3—We have no such data on hand but very probably some of our subscribers have and will communicate with us, whereupon we will be very glad to send you the information.

Remedy for Hot Starting Trouble

Editor The Automobile:—I would suggest that M. P. B. of Lakeport, N. H., who complains of trouble in starting a warm Ford engine, try shutting off the gasoline at the needle valve, then turning the engine over. When it fires quickly turn up the needle valve to normal position.

I have found this to be the cure for the trouble mentioned in numerous instances; the warmth seems to choke up the carbureter and manifold with an over-rich, non-explosive mixture.

Tarrytown, N. Y. J. J. H.

Needle Adjustment Is Too Fine

Editor The Automobile:—I have a Flanders 20, 1911 model. Last fall I put on a Schebler carbureter model L. I do not know just how to set it. If you shut the adjustment on the needle valve clear up it will hardly run. I have the air about half off.

2—What is the cause for about 1-2 pint of gasoline leaking from the carbureter out through the air pipe when the engine stops? Is the float set too high?

3—The magneto is a Splitdorf and I have trouble in short circuiting. I have put on an all new magneto cable but it goes through anywhere it happens to touch any metal. Can it be that the magneto is too strong? It runs well at other times.

4—Can you take up wear in the clutch on these cars? The flywheel has about 1-20-inch play between it and the housing. Does this harm anything?

5—Where can I get a light two-cylinder engine of a design similar to a motorcycle engine having 4 or 6 horsepower with a magneto?

Marathon, Ia. ORA SMITH.

—Evidently you have cut the needle adjustment down too fine and you should give it a turn and one-half on the needle and also adjust the air valve to seat lightly. Schebler model L is shown in section in Fig. 3.

2—The leaking is probably due to the condensation of the heavy gas in the manifold. When the engine stops it runs out in the manifold and back through the carbureter. The use of an exhaust sleeve or drum around the exhaust manifold and a flexible tube running to the air bend in the carbureter, will probably overcome this trouble. The height of the float should be 1 1-16 inches from the top of the bowl to the top of the cork float when the valve is seated.

3—The probable reason for the current leaking is that the insulation is not heavy enough or it has become worn in places where it has rubbed against the metallic surfaces. Probably leaking occurs on the wires at the point at which they pass through the fiber block over the exhaust manifold. It would be well to note if this block is properly in place.

4—The clutch can be taken up by increasing the tension on the clutch spring by an adjustment nut.

5—It would probably be most economical for you to purchase a used motorcycle or cyclecar with a similar type engine, as these will have the magneto attached. If a new engine is desired it can be secured from any of the motorcycle or motorcycle engine companies.

First Year for Dodge Bros.' Car

Editor THE AUTOMOBILE:—Have the Dodge Bros. ever had a car on the market before this year?

2—If so, what year and what was the name of it?

3—Have they ever manufactured the engines for Ford?

South Pittsburg, Tenn. W. F. A.

—This is the first finished car that the Dodge Bros. have had on the market.

2—The Dodge Bros. plant was erected especially for the present car and no others were manufactured before it.

3—Yes, they made the first engine for the Ford company but have had nothing to do with the model T engine.

Dodge Made First Ford Motor

Editor THE AUTOMOBILE:—I am under the impression that Dodge Brothers were the first to manufacture the Ford engine, being the holders of the patent, but their control ran out with the Ford on January 1, 1915. Am I right in this?

St. Johnsbury, Vt. G. F. CHAMBERLAIN.

—The Dodge Bros. did make the first Ford engine but were never concerned with the manufacture of the present model T motor. There is no patent control involved one way or the other and the Ford officials say there never was so far as the engine was concerned.

Magneto Probably Is Mis-Timed

Editor THE AUTOMOBILE:—I would like to know what makes the engine kick back when starting on the magneto.

2—How much oil is required in the crankcase of a six-cylinder motor?

3—Please show me by sketch the mechanism coupling between the clutch and gearbox of a 1911 Thomas model M.

4—How can I stop the oil leaking from this coupling?

5—How long will a magneto run without remagnetizing it and overhauling it in general?

6—How long is the average life of a spark plug?

7—What treatment is necessary to make a brake lining stick better?

Saugus, Mass. ROBERT E. REASON.

—The fault is that you have not retarded the spark sufficiently on the quadrant or if you have done this, the magneto is mis-timed.

2—It is impossible to give you exact data as to how much oil is required in the crankcase of a six-cylinder motor, as with different sizes of oil pan and different systems of ignition the quantity of oil will vary. The average six-cylinder motor, such as for example, the Hudson 6-40, will have 16 pints of oil but others will have less or more in accordance with their individual design.

3—The coupling between the clutch and gearbox of the 1911 Thomas model M is a cross-universal which is illustrated in Fig. 4.

4—The oil can be prevented from leaking from this coupling by removing the packing nut and replacing the felt washer with a new one. This can be secured from the Thomas company in Buffalo, at a very slight cost.

5—Magnetos will run for 5 years and upward without remagnetizing if a good job has been done in the first place and if the magnets employed have the proper degree of retentivity. The exact time cannot be stated but the service which you can secure from a magneto before it needs recharging will extend over an indefinite period of years.

6—The average life of a spark plug is two seasons. Some makes of plugs which are more costly and which have a better composition of non-burning material in their electrodes will last much longer than the cheaper plug. The average of two seasons may be taken as a mean for average priced plugs.

7—No treatment should be given a brake lining to make it fit better except keeping it clean and maintaining the proper adjustment on the brakes. When worn down the brake lining should be replaced. One of the frequent occurrences is the wearing of the asbestos compound below the surface of the copper rivets which hold it in place. This brings the copper rivets in contact with the metal brake band, greatly reducing the retarding effort of the brake.

To Install Atwater Kent System

Editor THE AUTOMOBILE:—I have a 1906 Mitchell. It never had a magneto on it, using dry cells only, but it does not give satisfaction. I have been thinking about installing an Atwater Kent system, but the timer shaft does not stand straight up and is close to the hood. Can you tell me how it can be arranged? Can it be driven by bevel gear from timer or can it be driven by gear or chain from crankshaft?

Bradley, N. J. G. A. MORGAN.

—The Atwater Kent system could be installed on this car by arranging a bevel gear drive from the timer shaft. This would be a better method than by arranging a chain or chain drive direct from the crankshaft.

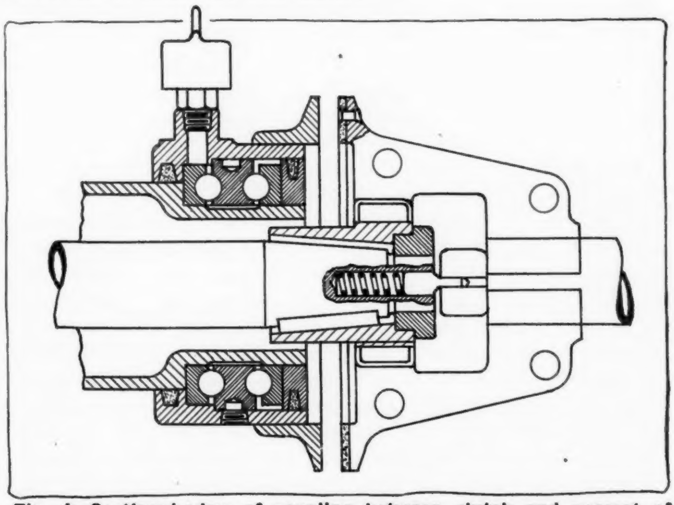


Fig. 4—Sectional view of coupling between clutch and gearset of Thomas model M

The Engineering Digest

Electric Bus, American in Details, for York, England

POSSIBILITIES for export of American-made omnibuses and also the chances for the electric storage battery type in cities of medium size are illustrated in the trial bus which has recently been supplied the city of York, England, by the Edison Accumulators, Ltd., the British concern representing the interests of the iron-nickel storage batteries. The bus holds only 22 passengers, all seated, and the driver collects the fares, and the vehicle is therefore frankly intended for leisurely traffic conditions and not for the crush of the metropolitan centers; but the market in this direction, here as well as in Europe, may be large in the aggregate as soon as it shall have been reasonably well established what type of vehicle is most suitable all the year round in the matter of service and low upkeep cost.

In the following are mentioned the design features which characterize the vehicle and some of the details which indicate the American origin.

The whole chassis without the batteries weighs 4,026 pounds and with body and batteries somewhat above 4 tons; the overall length is 17 feet 10 inches. The wheelbase is 11 feet 6 inches and the wheel gauge 5 feet 7 1/4 inches. The door where the passengers enter is on the near side close to the driver's seat, so that the reception of fares shall not retard the operation. All the battery cells used for propulsion are housed in compartments under the seats, as shown in dotted lines in the plan view of Fig. 1, and the load distribution effected by this arrangement should render it possible to lighten the construction. The battery comprises 64 Edison cells with 300 ampere-hours capacity, at 72 volts, for a five-hour discharge. One charge will drive the vehicle 40 to 45 miles at a speed from 10 to 12 miles per hour. The normal charging rate is 60 amperes for 7 hours, but short boosting charges between times will increase the mileage. The lighting is taken care of by an auxiliary battery kept under the driver's seat; it consists of 6 small cells connected to a switch which permits cutting out these cells when the main battery is boosted while keeping them in series parallel with the main battery for ordinary charging.

The frame of the chassis, shown in Fig. 2, is of rolled channel section reinforced along its central portion by an inner channel section liner filled with hard wood, making a strong and flexible box girder construction. The axles are low-carbon steel forgings. The front springs are under the frame, to give a large steering angle.

Rear springs are assisted by coil springs bolted to the frame over the rear axle, the coils making contact with a plate on the axle when the vehicle is half loaded, this permitting the vehicle to run with little bouncing when underloaded. The wheels are of hickory wood with solid rubber tires and run on one double and one single row of ball bearings totally enclosed in oiltight hubs. The transmission brake and the wheel brakes are both operated by pedals, leaving the driver's hands as free as possible. Power is transmitted from the motor, which is supported entirely in the frame, as shown in the illustration, to the differential countershaft by a tempered flat steel blade, which cushions the starts of the vehicle by its torsion, and also the stops if these are effected by the transmission brake. At the motor end this transmission shaft enters by means of a large square slip joint. Universal joints are dispensed with by this construction. The differential is mounted in Hyatt bearings with balls for the end thrust, while the drive shaft is carried in double rows of balls. The wheels are driven by sprocket chains from the countershaft.

The motor is of course designed for the peculiarities of the Edison battery, taking a normal current of 40/72 ampere-volts at a speed of 900 revolutions per minute. It has a large slotted commutator similar to the commutator on a railway motor and works with fixed brushes. A continuous torque drum controller, giving five forward and two reverse speeds, is placed under the small hood in front of the dash and is operated by a handle above and concentric with the steering wheel. Ampere-hour meter, safety switch and lighting switches are also under the hood, with the dial of the meter inset in the dash in constant view of the driver. It registers actual ampere-hours when the battery is on charge. —From *The Engineer*, March 19.

Valveless Pump with Tubular Piston for Liquid or Air

AMONG the considerable number of high speed pumps for various purposes which have been developed in recent years with a view to avoiding the power waste and upkeep trouble due to the close piston fits in reciprocating pumps, the May-Nelson construction, which is of American origin,

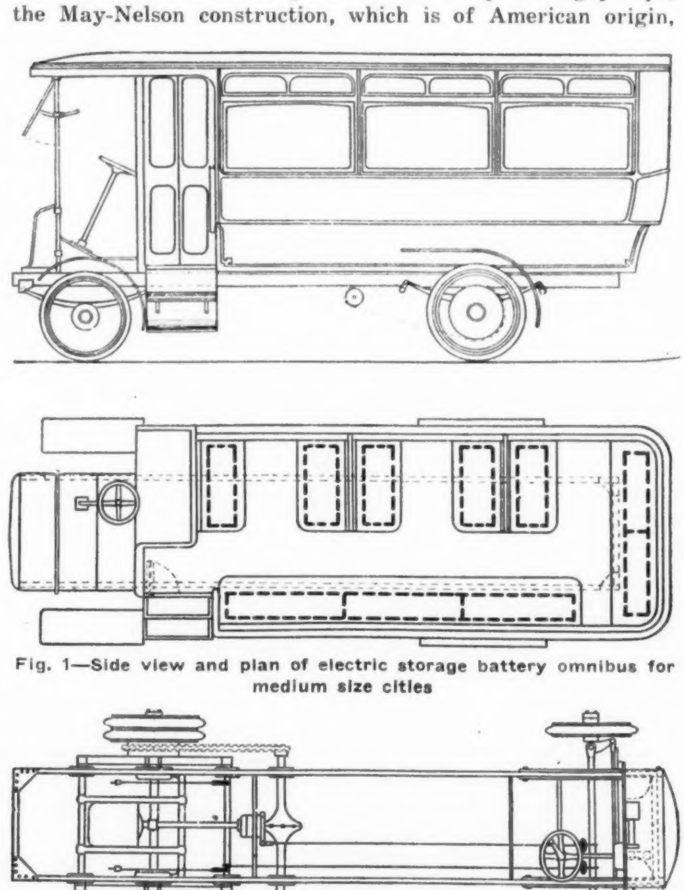


Fig. 1—Side view and plan of electric storage battery omnibus for medium size cities

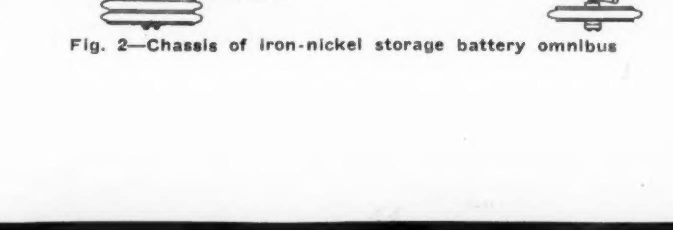


Fig. 2—Chassis of iron-nickel storage battery omnibus

presents some features which may bring it under consideration for automobile purposes, as either a water, oil or air storage pump. It differs from the true rotary pumps, which are also valveless, in that its piston does not participate in the rotary movement of the shaft of the eccentric by which it is actuated but is merely made to oscillate freely in all directions around its own axis. It is composed in the main of a tubular cylindrical body E, Fig. 3, in two pieces connected by a radial partition F, and of a hollow tubular piston G which is oscillated by two eccentric disks, not shown.

The bottom of cylinder E has two ports O and P, one on each side of the radial partition, which serve, according to the direction of rotation, as intake and delivery ports for the displaced fluid. The illustration shows four successive positions of the piston, 90 degrees of rotation apart, from which it is seen that the two spaces separating the exterior and interior piston walls from the exterior and interior tubes of the double cylinder are moved around in such manner as to create suction in the space to the left of the partition and pressure in that to the right.

It is stated that with a single cylinder a pressure of 45 pounds per square inch can be obtained, and when three cylinders are arranged in series and used as a condenser pump for air, either dry or humid, the atmospheric pressure can be reduced to one fiftieth of an inch.—From *Génie Civil*, March 13.

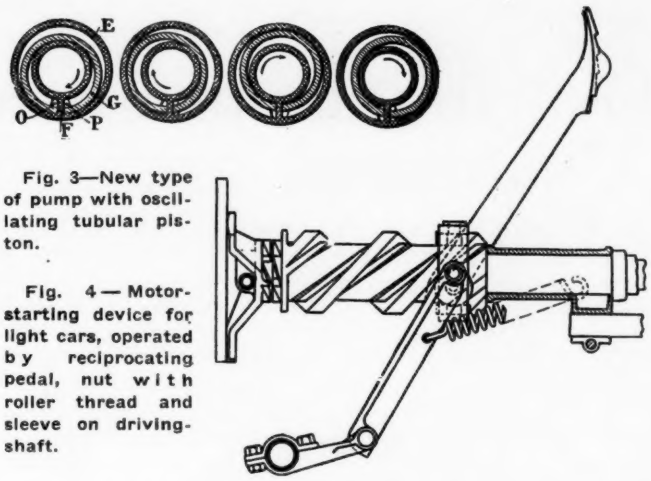


Fig. 3—New type of pump with oscillating tubular piston.

Fig. 4—Motor-starting device for light cars, operated by reciprocating pedal, nut with roller thread and sleeve on driving-shaft.

Foot Pressure Motor Starter Device for Very Light Car

IN a lengthy description of the Horstmann light car the starting device shown in Fig. 4 is mentioned as effective and convenient. Its practicability depends however on having the change-speed gear mounted upon the rear axle, and the cone clutch shaft and spring are also abbreviated to make room for it. It acts upon the flexible joint at the front end of the driving shaft by means of a ratchet tooth clutch of the same kind that is used with ordinary starting cranks. One part of this clutch is formed upon the front end of a quick-threaded sleeve which is free to revolve upon the driving shaft. The first movement of the pedal, by the reciprocation of which the starting is effected, engages the catch, and further pressure rotates the sleeve by means of a box with rollers arranged to take the place of a threaded nut of the same pitch as the sleeve thread. When pressure is taken off the pedal a coil spring returns it to the rear end of the sleeve and disengages the ratchet tooth grip. A rapid to-and-fro movement of the pedal will thus keep the motor shaft revolving as long as required for making the start.—From *Automobile Engineer*, March.

How War Affected Automobilism in Switzerland

All Private Traffic Stopped—Factories Rushed with Work

FOR six months after the beginning of the European clash the use of automobiles for private purposes was entirely prohibited in Switzerland. The country suddenly roused to take active steps to protect its armed neutrality depended for mobilization entirely upon the Swiss Volunteer Automobile Corps and the vehicles owned by citizens. These were all duly registered and it was a matter of only a few days to pick from the lists those suited for the military work, to requisition them and to have them delivered up to the authorities. The cars unsuited for the work might have been left in the possession of the owners if it had not been for a shortage of gasoline and tires in the country. It had been neglected to lay in supplies of these articles, and the government found it necessary to make sure of them for the army by forbidding everybody else to make use of them. Even in the army only the superior officers were allowed to use fuel for personal transportation, so long as the difficulties had not been met.

Very large orders for motor vehicles reached the Swiss factories, on the other hand, from Germany as well as from France, after home orders had entirely ceased. Night shifts were put to work, and one factory in the eastern end of the little country, close to Austria, is putting up new factory buildings to increase the production. On November 27 the government prohibited the export of automobile motors and of construction parts, but the export of complete vehicles was allowed under permits in each case, and many private owners shipped the vehicles abroad which had become useless to themselves. A peculiar effect was a boom in bicycles. All stocks in this article were soon sold to physicians and business persons who could no longer drive cars. Especially in Geneva, which was known as the Eureopean city having the largest number of automobiles per capita, the disappearance of the cars and the reappearance of the bicycle became noticeable in the street life.

Gasoline which was found on private hands was bought up for the army, but the prices paid were so low that no private initiative for getting the supplies renewed from abroad was encouraged, and only a total of 811 tons of gasoline reached the country in August, September and October, as compared with a normal importation of 5,000 tons during these months. In November larger quantities arrived and the trade in fuel was released, but the use of cars remained under severe restrictions for lack of tires. A Geneva importing firm offered to supply all the tires needed by the government, and meetings of protest against the continued prohibition were held in different parts of the country, but even these actions were without effect for a time, as the government had entered into a previous contract with a different tire-making concern whose large shipments were held up in Italy. Lubricating oil during all this time rose to very high figures, as new oil stores were detained in the port of Genoa for several months by the Italians.

Finally the difficulties were gradually overcome to such an extent that on February 1 the government allowed motor traffic again in all of Switzerland and also released the trade in tires subject to new restrictions that might be adopted at any time if found necessary for the defense of the country. Since then normal conditions have been re-established, with the number of motor vehicles in circulation greatly reduced, however.—From *Allgemeine Automobil-Zeitung*, March 20.

Distribution of Forces Between Cushioned and Uncushioned Components of Sharp Shocks

Discussion of "The Improvement of Spring Systems"

By M. C. K.

WHETHER it is worth the while to take special constructive measures for protecting motor vehicles against the horizontal component in severe road shocks was the fundamental question which was raised and answered by the writer without any attempt at impossible precision but with a view to getting all the essentials in the subject before the reader's intuition so strongly and vividly as to rouse opinions. Fellowcraft and W. C. M. took up the constructive end of the subject, in approval of the general idea but somewhat in opposition to the writer's suggestions on the advisability of providing SEPARATE means for cushioning the horizontal element of shocks in the case of motor vehicles which are operated with tires giving little relief for this element. Finally Fellowcraft presented in the April 8 issue a demonstration to the effect that the ratio of the horizontal and vertical shock forces cannot be higher than 1 : 1.61 in the case under discussion, the inference being that both are best cushioned by the same spring.

M. C. K. must try to show that the ratio of forces, as figured by Fellowcraft, is not demonstrated in accordance with the complete set of conditions of the road shock, and that it would be less interesting for practical purposes, even if it were fully demonstrated, than approximate figures for the shock in terms of work. And with regard to the work figures F. has come to agree substantially with the estimates of M. C. K., though by following different (and on the whole better) methods.

First it should be kept in mind that the whole inquiry from the beginning was intended to result in conclusions of interest for the improvement of spring systems. The assumption of a perfectly rigid vehicle and equally rigid road obstacle was introduced to simplify reasoning and not to trap the reasoner into deductions which may be defended theoretically but become faulty in the degree as practical elements are admitted.

F.'s reasoning is most conveniently followed by turning to the issue of April 8, pages 630 to 632.

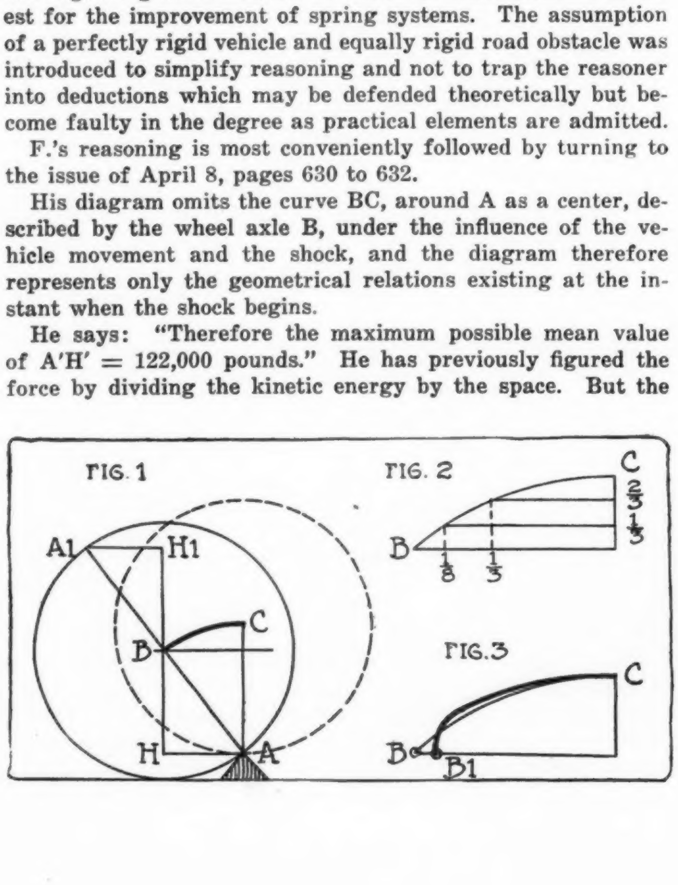
His diagram omits the curve BC, around A as a center, described by the wheel axle B, under the influence of the vehicle movement and the shock, and the diagram therefore represents only the geometrical relations existing at the instant when the shock begins.

He says: "Therefore the maximum possible mean value of A'H' = 122,000 pounds." He has previously figured the force by dividing the kinetic energy by the space. But the question is not of "a mean value." This term may be useful for an estimate, but it is misleading for a demonstration of exact figures, as the shocks depend upon the maximum forces. The omitted curve BC, re-inserted in Fig. 1 herewith, shows *per se* that the force of the shock is concentrated at and near B and dwindles rapidly toward C. If it is practically all concentrated upon 1-5 of the shock space, the maximum force value becomes 5 × 122,000 pounds. But it is really of no interest to determine, in this manner, the resistance which would exhaust the kinetic energy of the vehicle in a space of 10.53 inches or 1-5 of this space, as we know it will not be exhausted by the little shock in question. And F. recognizes this by having no other use for this irrelevant figure than for making it appear "evident," by comparison, that the figures of interest should "be determined by the component H'B—"; that is, that the figures for the horizontal shock should be determined from the figures for the vertical shock alone. And, as this is what he set out to prove, the so-called vicious circle is to that extent a factor in his argument, despite its apparent stringency.

This flaw does not happen to be vital, though, as his conclusion may be correct for other reasons, not given. But F. arrives at a value for R "the mean vertical force" by again assuming that there is question of mean forces. Again without regard to the movement represented by the curve BC, he figures a "mean vertical acceleration" from a space of 3 inches, getting a "mean vertical force," R = 12,676 pounds. Now, if the vertical force is practically spent during the first inch of the 3-inch rise, F.'s figures for *a* and R should be multiplied (by more than 3). Whatever the factor of multiplication, this would increase the figure for the horizontal force in the same ratio, according to F.'s geometrical contention, and his ratio would still hold, IF AND PROVIDED it could be assumed that the distribution of the horizontal force over the space of 10.53 inches followed the same time schedule as the distribution of the vertical force follows over the space of 3 inches. But there is no reason for this assumption. The shape of curve BC in fact excludes it, and curve BC represents the nature of the obstacle, which is of the kind that gives the sharp shocks and the most pronounced horizontal component of a shock. Fig. 2 shows, for example, graphically that 1-3 of the rise is finished before the vehicle axle has advanced more than about 1-8 of the distance from B to C and that 2-3 of the rise corresponds to about 1-3 of the horizontal space.

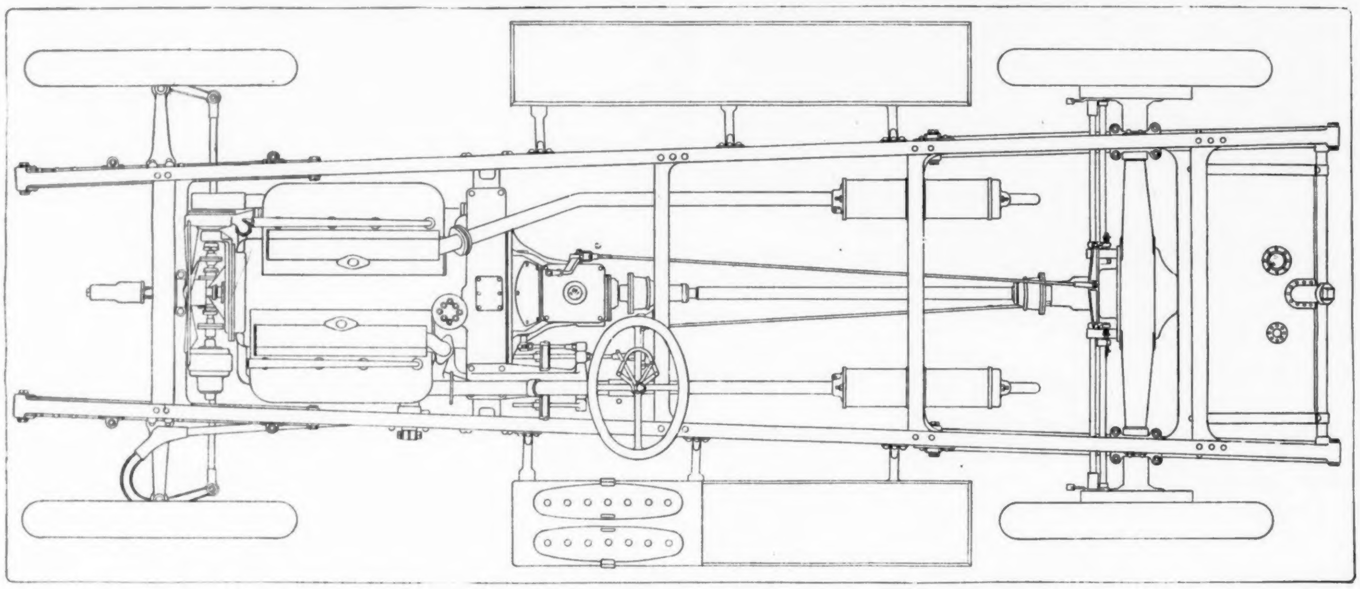
It is plain that the horizontal shock is much more nearly instantaneous than the vertical one, that it is condensed on a smaller proportion of its space, and that its maximum therefore is more severe than the geometrical relations in F.'s diagram would indicate. Perhaps the horizontal component decreases during the period of 0.01755 second as the lengths of the half-chords in Fig. 2 and the vertical component inversely as the ordinates of curve BC. At all events, F.'s demonstration is not a cogent demonstration for the relations arising during the progress of the shock. And the fundamental trouble with its pertinency is that the whole idea of a "mean vertical acceleration" is incongruous with the circum-

(*Continued on page* 729)



Careful Detail on Standard Steel Cars

Big Railroad Suppliers' Cars Use Well-Known Units—Individuality Observed in Smaller Fittings—Good Bodywork a Feature



Plan view of chassis used in the eight-cylinder model of the Standard Steel Car Co.

STANDARD STEEL CAR automobiles, the existence of which was announced a few weeks ago, are to be made only in small quantities, for this year at least. Cars have been assembled and partially made at the company's works in Butler, Pa., for some time past, but it is only lately that they have been got into line for introduction on the market. Most noticeable at first glance, is the good bodywork with high finish and harmonious lines. Careful examination discloses no radical features but an excellence of detail that is unusual and there is a well-defined practicality about everything. The design is the work of men who have a great experience of the road and the repair shop, so it contains no fads whatever but plenty of those little inconspicuous things that make for satisfactory service.

Six and Eight Similar

There is not much difference between the six and the eight, beyond that in the motors which are both Herschell-Spillman types, the six being 4 by 5 1-2 inches and the eight 3 by 5 inches bore and stroke. These dimensions give capacities of 415 cubic inches and 282 cubic inches for the six and eight, respectively.

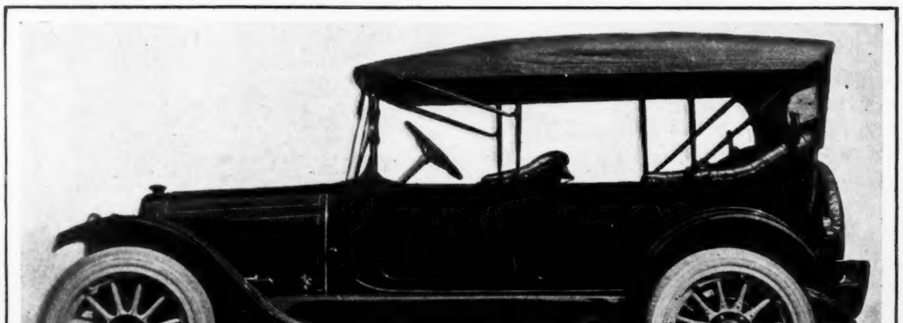
Thumb Nut Brake Adjustment

On the six the rear axle is a Weston-Mott with thumb nut adjustment for the service brake, but the eight has a Timken axle. Both clutch and gearset are products of the Warner Gear Co., the clutch being multiple-disk with Raybestos facing, the transmission being identical for either chassis. Behind the gearset, however, there is a difference, as the six has a torque tube with a wide armed fork anchored to swivels on the frame, while the eight has a simpler construction as shown in the drawings.

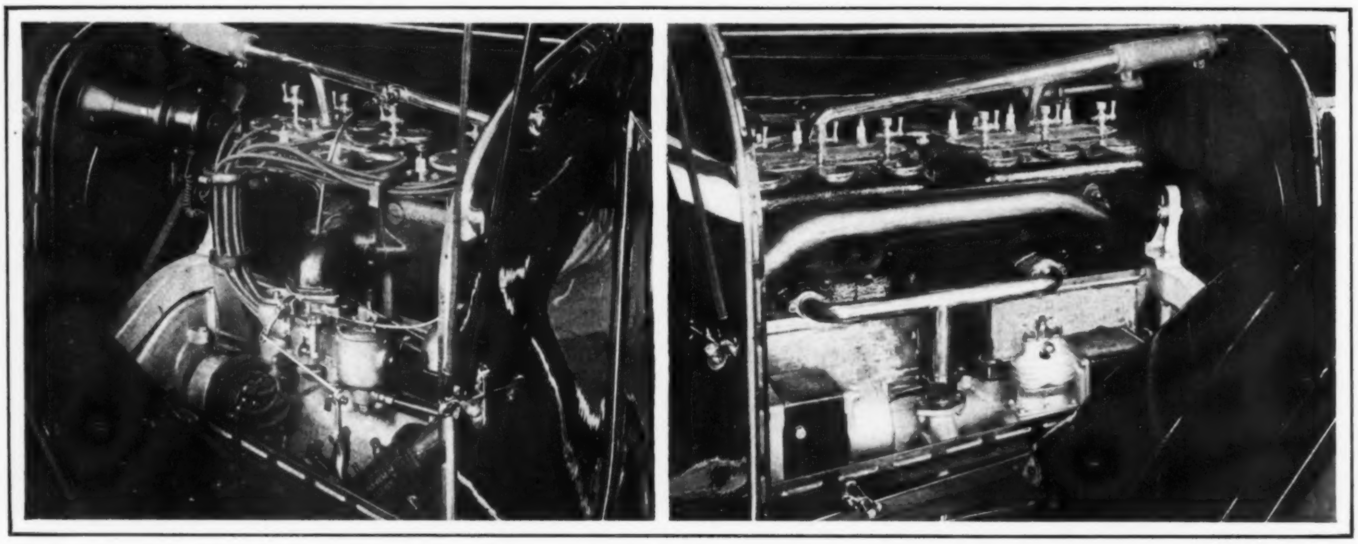
The plan view of the chassis shows the tapered form of frame used, and it is interesting to observe that the springs are mounted directly beneath the frame sills, so they also taper towards each other. The makers originally designed the frame to taper, but mounted the springs so that they lay parallel, but experiment showed that there was no disadvantage in allowing the front ends of the springs to be closer together—if anything it might add a little to the lateral stability of the car.

Starter Detail Simple

The electrical equipment is Westinghouse two unit, the combined generator and igniter being employed. The generator is located on the right side of the motor in the six, and the water pump is driven in tandem with it, the coupling attaching to the free end of the armature shaft. In the



Six-cylinder Standard Steel touring car



Views of Herschell-Spillman motor in Standard Steel six-cylinder, showing disposition of starter, generator and magneto

eight, the same sort of generator is situated in front of the motor.

The starting motor in both six and eight lies on the right side and meshes with the flywheel through the medium of a Bendix drive and there is an especially ingenious control for the starting operation. At the end of the ignition lever quadrant on the steering wheel there is a sort of trigger which prevents the spark lever from being brought right back to the limit of its possible travel. This trigger is bent over the end of the quadrant, and pressure with the thumb will lift it so that the spark lever arm can slip underneath and come to the extreme end of the quadrant.

At the foot of the steering column, attached to the lower spark lever, is a contact which is brought against another fixed contact, when the trigger is lifted and the spark lever brought right back. It is these contacts that control the starter current, so the switching in of the starting motor is done by the spark lever. This construction has the advantage that it renders absolutely impossible any attempt to start without retarding the ignition. With the Bendix drive, although it will withstand backfires, they impose a stress which is not desirable if repeated constantly as it might easily be by a poor driver. The idea of combining the starter switch with the spark lever is thus peculiarly happy since it gives a safeguard while adding to convenience.

All Wiring Part of Chassis

The cowl board though it appears as part of the body, in the customary way, is really nothing of the sort, since it is mounted on brackets attached to the frame. The body merely drops over the cowl board and the two parts are joined together by a few screws which prevent any chance of rattle. This enables all the wiring to be done under the best possible conditions, out in the open where the whole length of each wire can be seen at once. There is no feeding through holes or screwing to terminals that themselves are out of sight. All wires are contained in copper pipes which are said to be better than flexible tubing, as they are absolutely and permanently waterproof. Since it also carries all other instruments, the cowl board completes the chassis and makes it a vehicle with everything save seats for the passengers. Any kind of body can be put on, and a body can be taken off, without interfering with ability to drive the car.

Gearset and clutch. Note multiplying levers

Hollow spring shackle bolt

Points of Difference

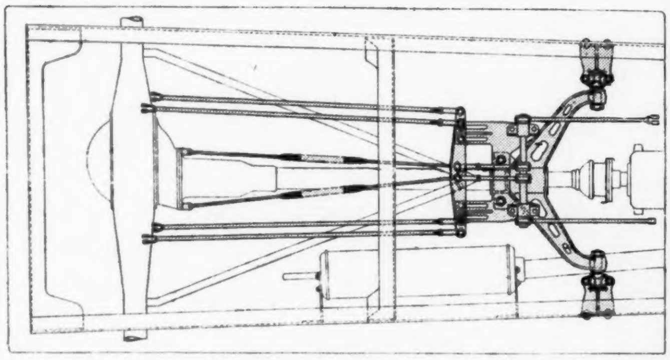
For gasoline feed the six has an air pump on the motor, and the eight uses the Stewart vacuum tank, but this completes the list of differences so far as the motors are concerned. Another difference is found in the spring suspension, since the eight has half-elliptic rear springs while those on the six are three-quarter pattern, and the last point in which one car does not resemble the other is in the spare tire mounting, the eight having running board location and the six a rear end tire carrier.

Summing up, it will be seen that the eight, which is the later model, is slightly more simple in several respects than the six chassis which doubtless accounts for the fact that the eight is the cheaper car.

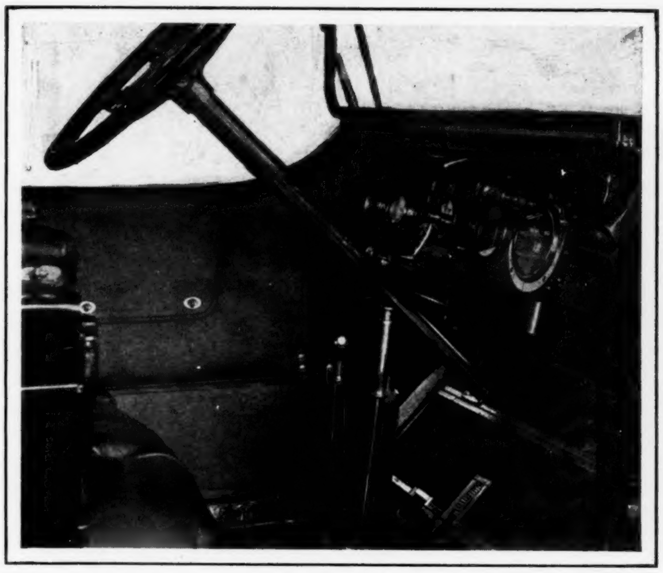
Of the bodies the keynote is comfort combined with smooth exterior; a streamline design without extremes, and the hoods merge nicely into the bodies. All the fittings are of good quality, good upholstery is used and the tops are double thickness Fabricoid that can be washed inside or out with soap and water.

A petty detail which shows how well the car is cared for in design is the spring bolt used in all the shackles. This is hollow and arranged to contain a fair quantity of oil, so that it is only necessary to fill it up every few weeks. The outstanding advantage of supplying oil to spring bushings from inside the bolt is that it is likely to distribute more evenly than is grease forced into the bushing in the ordinary way. Of course it is more expensive, but in this sort of way no expense has been spared in the Standard Steel cars.

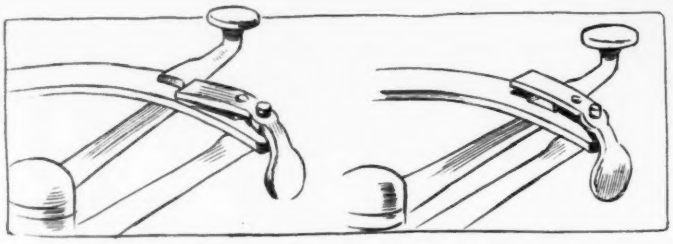
Of the two cars, the six has the longer wheelbase, being 126 inches to the eight's 121, also the tires are 36 by 4 1-2 on the six and 35 by 4 1-2



Torque tube arrangement used for six-cylinder Standard Steel car



Cowl board with instruments is part of chassis. Note accelerator sector set in toeboard



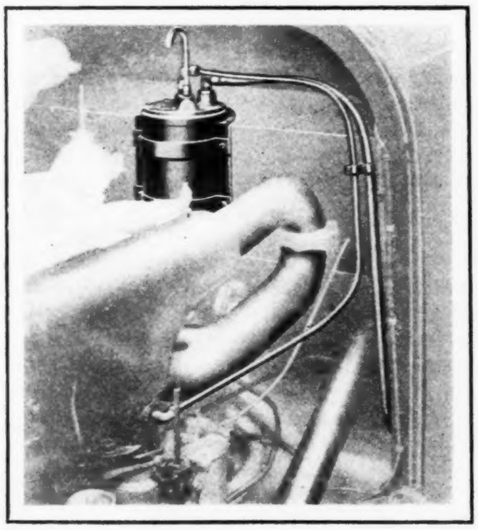
Details of trigger on spark quadrant which controls starting motor

on the eight. The makers intend the six to take larger and heavier bodies than will be supplied with the eight, though both have the same capacity—seven passengers—in the standard touring types. In the Pittsburgh showrooms there are some fine examples of costly inclosed bodywork on the six-cylinder chassis but so far none of these have been catalogued. The prices for open bodies, and with complete equipment as outlined above and including tire pump on motor, are $2,100 for the six and $1,735 for the eight.

Special Mounting for Vacuum Tank on Premier

INDIANAPOLIS, IND., April 17—In designing the new 6-50 model, the engineers of the Premier Motor Mfg. Co., have given close attention even to such details as the mounting of the dash tank of the Stewart vacuum gasoline system. A special niche is provided for this in the cowl board of the body as shown in the accompanying illustration and into this the tank is securely fastened by collar band of steel 3-32 by 7-8-inch which extend around half the service of the tank, the remainder being embedded in the groove in the cowl. The bands are fastened to the underside of the cowl by four machine screws.

The location of the tank behind the motor protects it from air currents while the heating of the gasoline in the tank due to its proximity to the cylinders insures easy vaporization, economy and thorough combustion of the fuel. The tank is mounted sufficiently high to insure ample gravity for the gasoline feed pipe.

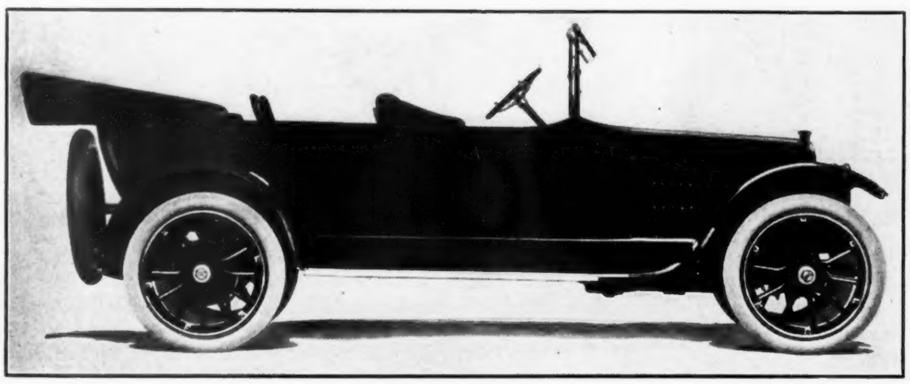


Mounting of Stewart vacuum fuel feed tank on Premier 6-50

New Seven-Passenger Chandler

CLEVELAND, O., April 17—The accompanying illustration shows the new seven-passenger touring car brought out by the Chandler Motor Car Co., to replace the former five-passenger type as announced in THE AUTOMOBILE for April 1. The new model, with a roadster built on the same chassis forms the company's line. With either body it sells for $1,295.

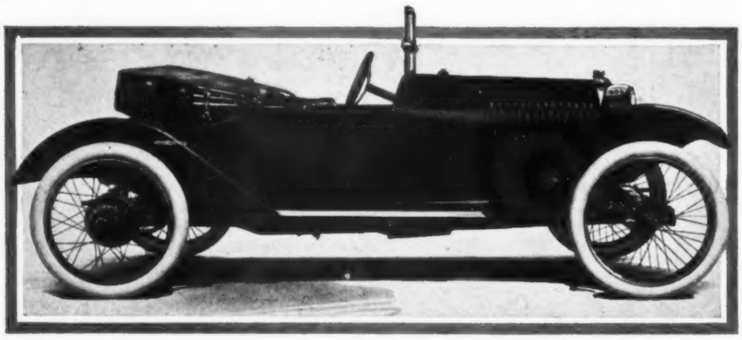
Apart from lengthening the wheelbase of the chassis from 120 to 122 inches, there is no chassis change from the former model. In the new body are two folding seats which when not in use fit snugly into recesses in the back of the front seat and are covered by flaps; when opened they are self-supporting and require no screws or other hand adjustments. There are no supports under them which gives maximum leg-room for the rear seat passengers.



Left — New seven-passenger Chandler touring car at $1,295

Body Acts as Frame in New Cornelian

Two-Speed Gearbox with Only Three Gears and No Countershaft—Unusual Springing



New Model Cornelian roadster which with wire wheels sells for $410

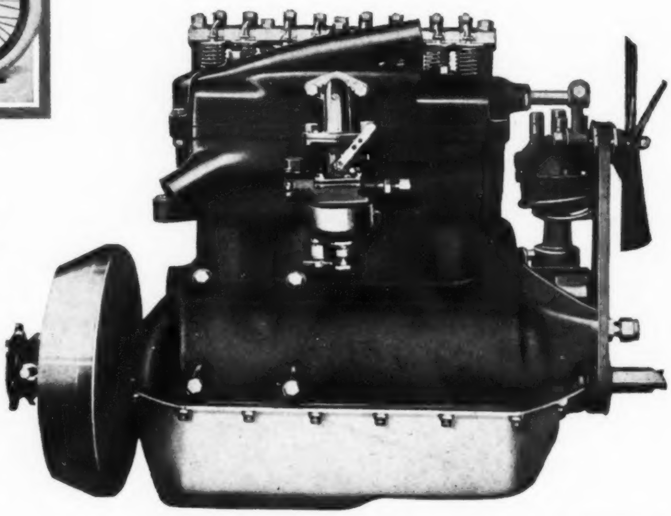
MORE than passing interest attaches to the new model Cornelian car, which is in roadster form only, and of the lighter type. It is made by the Blood Brothers Machine Co., Allegan, Mich. This concern, which for a number of years has been identified with the automobile industry as a parts specialist, began the making of its distinctive roadster type some three years ago, and was located in Kalamazoo, Mich., until last year when the move to a well-equipped new plant at Allegan was made.

It will be remembered that the Cornelian car was first brought to the notice of the general public at the time when the cyclecar was at the height of its popularity. But while most of the cyclecars were of narrow tread type, the Bloods stuck tenaciously to the standard 56-inch tread width, which they retain in this latest model.

The Sterling four-cylinder motor of 2 7-8 by 4 inches delivers 13.4 horsepower by the S. A. E. formula. The clutch is a leather-faced cone; Atwater Kent ignition is used; a Holley carbureter furnishes the mixture. Other specifications take in a transverse spring system, floating rear axle, left drive, center control, wire wheels, 28 by 3 tires, shaft drive, and wheelbase of 100 inches.

Peculiar Two-Speed Transmission

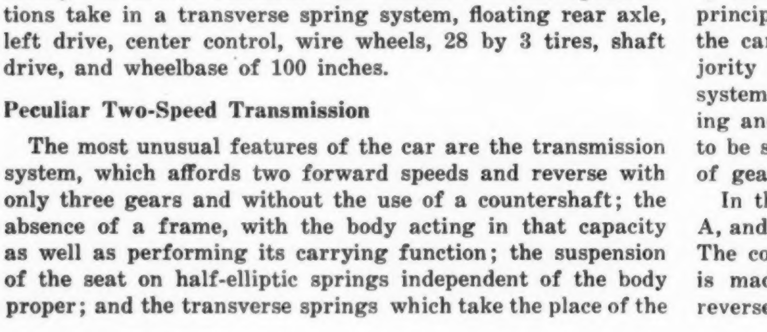
The most unusual features of the car are the transmission system, which affords two forward speeds and reverse with only three gears and without the use of a countershaft; the absence of a frame, with the body acting in that capacity as well as performing its carrying function; the suspension of the seat on half-elliptic springs independent of the body proper; and the transverse springs which take the place of the regulation form of axles, combining lightness and strength.



Intake side of four-cylinder block motor used in new Cornelian, showing mounting of carbureter and Atwater Kent timer-distributer

Referring to the illustrations, the unusual transmission system with its unique design will be made clear. While this principle has been used by the Bloods since the inception of the car, nevertheless, it is undoubtedly new to a great majority of the automobile public. The entire transmission system is in unit with the rear axle, and consists of a sliding and rocking member which is so mounted as to allow it to be swung from side to side and thus mesh the desired set of gears.

In the views shown, the sliding and rocking member is at A, and it will be seen that it is fitted with two gears, B and C. The control or shifting rod is at D, and driving connection is made through the annular gear E for low speed and reverse. For high speed, or direct drive, the gear B meshes with the small female clutch member F which is rigidly attached to the carrier of the large annular gear E, and thus drives directly the pinion connecting to the regular form of bevel differential ring gear. When driving direct, then, the gear B acts as the male member of what might be regarded as a dental clutch, and does not revolve free of the driving shaft G, but forms a solid drive from this shaft to the bevel pinion.



Two-speed gearset and differential. Gearbox has three gears for two forward speeds and reverse

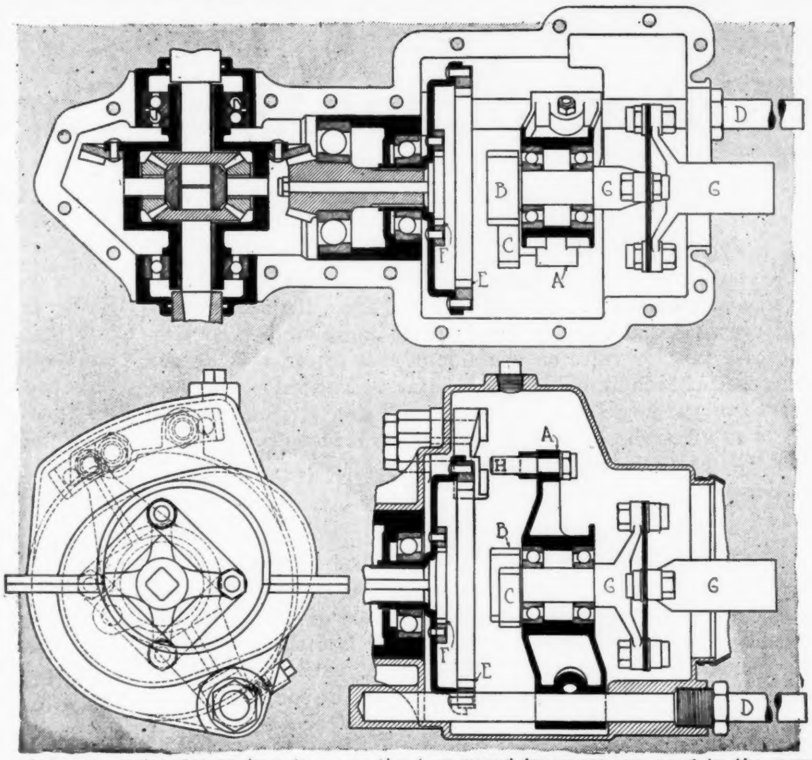
It will be noticed that the rocking arm A is rigidly attached to the shifter rod D, which is operated from a control lever at the driver's hand. To obtain first speed, the control lever is thrown so as to turn shaft D to the left, considering the observer to be facing forward. This swings arm A to the left also, after which it slides arm A back so that gear B meshes with the annular gear E, making a driving connection through the two gears to the rear axle. In the top of the arm there is an index

pin H which registers with guide holes in the top of the housing to make the sliding positive. That is, this pin properly positions the arm so that the meshing will be correct. When connected thus, gear C is idle.

Now suppose that high speed, or direct, is desired. The control lever first brings the arm A forward, thus unmeshing the gears. Then it is swung so that gear B is in line with the shaft. Pushed back now, the index pin positions it correctly that the dental clutch action may be obtained, gear B being wider than gear C so that B can slip into the female portion F without interference from gear C, which causes the whole mechanism to revolve together at the same speed.

To get reverse, the arm A is swung to the right, and when slid back gear C meshes with gear E, and the latter is thus turned in the opposite direction from shaft G, through this intermediary gear, the drive being through gear B, which is now clear of the annular gear, to gear C, and thence to gear E.

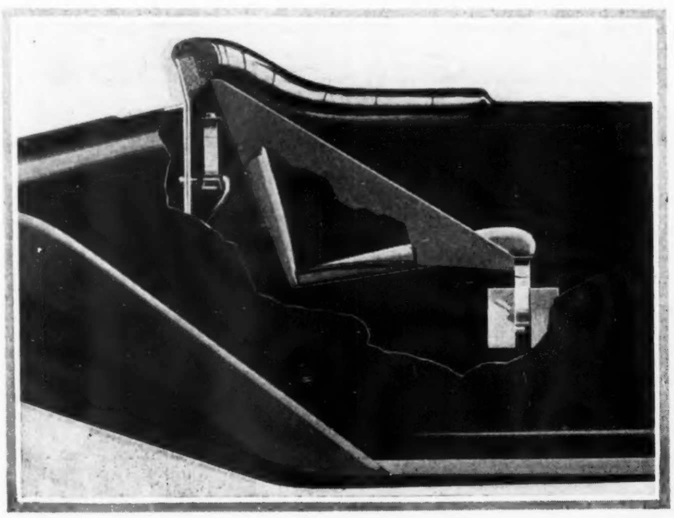
This change-speed system therefore really employs only three gears, whereas the conventional gearset for two forward speeds and reverse would require at least six gears. This is exclusive of the differential and bevel driving gears, which are the same in either the Cornelian or the conventional drive. There would also have to be a countershaft in the conventional set, the sliding and rocking arm feature of this unusual construction doing away with that also in the Cornelian. The shafts all run on New Departure bearings.



Upper—Horizontal section through the two-speed transmission used in the new model Cornelian. Lower left—End view through the system. Right—Vertical section

Axles Are Leaf Springs

The rear axle itself is of peculiar construction, making for extreme lightness. It is a floating form, and of a type used by De Dion. Just outside the differential housing, each axle shaft is fitted with a universal joint K, as shown in the illustration of the transmission system. Instead of being inclosed within an axle tube or housing, these axle shafts run open to the wheels. Long transverse springs form the axle proper, two below the axle shafts and one above. These form a platform which suspends the body. Thus the universal joints take care of any slight alteration of the relative position of wheels and differential due to action of the springs. The ends of the springs attach to the wheel hubs, and hold up body and driving system at their center.



Seat suspension in the new Cornelian is independent of the body, the seat being carried on long semi-elliptic springs

The front spring suspension is similar to the rear, the transverse springs taking the place of an axle and performing their spring function as well. However, only two springs, one above the other, are used in front instead of three, they attaching to the vertical wheel spindles at their ends.

While on the question of the springing, the novel seat suspension free of the main body should be mentioned. One of the illustrations brings this out. The seat at both bottom and back is suspended on two long half-elliptic springs, which act independently of the car springs to make an exceedingly comfortable riding proposition.

No Chassis Frame Used

Lightness is further promoted by the entire absence of a frame, the body itself performing that function and making the bridge between the two axles. It is constructed entirely of steel, ribbed and reinforced, and thus has strength enough to take the place of the conventional frame. This feature, together with the axle construction makes a low center of gravity, it is pointed out, and therefore reduces the unsprung weight to a minimum.

The motor is a standard Sterling type with overhead valves, and 18 horsepower is claimed for it. It is thermo-syphon cooled, and cylinders are cast in a block. The upper half of the crankcase and the cylinders are in one piece, but the cylinder head, carrying the valves, rocker mechanism and spark plugs, is detachable. The constant level, circulating splash system of oiling is employed, whereby the oil is drawn up by a pump from the reservoir in the bottom of the crankcase and distributed to the individual splash troughs. The connecting-rod ends dip into these troughs and throw the lubricant to all the bearing surfaces.

The crankshaft is carried on two bearings, both of die cast babbitt, 3 inches long and 1 9-16-inch in diameter. Valves, of regular poppet design, have a total diameter of 1 1-4 inch, with a clear opening of 1 1-8 inch. The connecting-rods, 8 inches long, work with pistons having three rings each and the timing gears are helically cut.

At the price of $410, the Cornelian has two gas headlights, tail light, generator, tools, and so on. Electric lights and cranking are extra. The top and windshield are $25 extra.

Walker Motor Uses Cored Rotary Sleeve

Single Balanced Valve Worm Driven from Crankshaft

A ROTARY valve motor in which the valve mechanism has but four moving parts has been produced by W. N. Walker, Rome, N. Y. As will be noted from the accompanying drawing, the valve action is exceedingly simple, consisting of a tubular valve on one side of this motor, serving the purposes of both an exhaust and intake. The valve is driven by worm gearing from the crankshaft and is made in two parts to allow for expansion throughout its length. Each of the two parts is driven independently off opposite ends of the crankshaft.

Gas Distribution by Ports

Distribution of the gases is accomplished by ports in the rotary valve. The intake gases pass through a series of radial ports surrounding the middle section of the valve, admitting the mixture from the carbureter into the interior of the tubular valve, whence it is distributed to the various cylinders in the customary manner by means of radial slits opposite ports.

The valve is shown in detail in the accompanying illustration. As will be seen, it is a balanced construction, small ports leading directly through the valve disposed in suitable angular relation to one another to permit the cylinder pressure to be equalized on both sides of the valve, whenever the port is closed. This balances the pressure on the wall of the valve and prevents excessive friction due to an unequalized load.

The gases enter through the intake manifold at and pass directly into the central portion of the valve. The interior of the valve only takes care of the intake gases. The exterior portions, as shown in the accompanying illustration, are recessed at B to provide a passage for the exhaust gases. The timing of the motor is of course determined by the peripheral spacing of the intake and exhaust ports in the valve. The recesses for the exhaust conduct the exhaust gases to one or the other of two circular depressions placed midway between the first and the third and fourth and sixth cylinders respectively. These are shown at C and D.

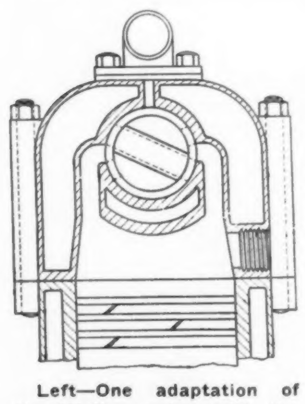
The passage of the gases is thus readily explained; entering from the intake manifold at A they are free to pass into the central portion of the valve and are then subject to the suction of the cylinders on the intake stroke. The valve slots are so arranged that they are open in accordance with the following timing. Intake opens at 10 degrees past upper center and closes 30 degrees past lower center. The exhaust opens 50 degrees before lower center and closes 5 degrees past upper center. The area of the port is 7-16 by 3 1-4 inches. On the experimental motor to which these dimensions and timing apply the cylinder dimensions were 3.5 by 4 and the number of cylinders, six. The valve rotates at one-quarter crankshaft speed.

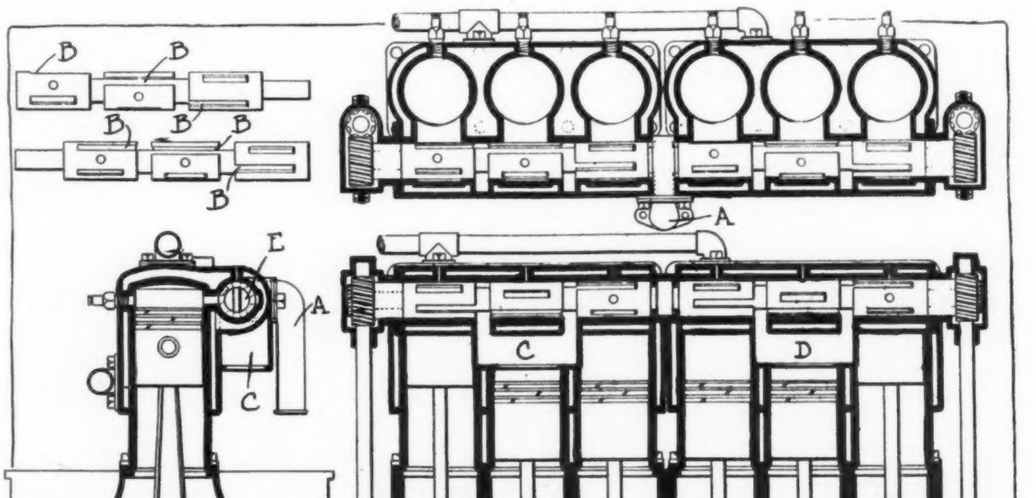
The valve timing is set from the end of the valve and when arranged for one cylinder is correct for all three, the valve being split at the center. The cooling of the valve is taken care of by waterjackets which completely surround the valve housing except at the port opening. This is shown in the accompanying cross-section at E. In addition, cooling is also effected by exposing the walls of the valve chamber to the cool incoming mixture, which, as it undergoes a certain amount of vaporization, absorbs heat, thereby reducing the surface temperature.

Valve Clearance .001 Inch

The clearance between the valve and its chamber is .001-inch and it is claimed that with this clearance and because the valve is balanced there is no difficulty in shearing the film of lubricating oil. It is additionally claimed that the very low temperature attained by the valve is evenly distributed through the entire valve section and therefore distortion will not result from unequal expansion.

The motor, as illustrated herewith, is only one of the forms in which it is possible to arrange the valve. If desired, it can be placed directly in the center of the combustion space as shown at L.





Left—One adaptation of the Walker valve with the sleeve in center of combustion space

Right — Walker balanced rotary valve on side of motor showing details of construction of the valve and the coring necessary in the cylinders for the water jacketing and manifolds. Note double-end drive for the valve from both ends of crankshaft

Distribution of Force Between the Components of Sharp Shocks

(*Continued from page* 722)

stances. We know that such an acceleration of 405.5 feet per second (per second) could not be reduced to nothing at C without any other force than gravitation to reduce it. There is therefore in reality question of a different and more irregular force. Perhaps it may help the intuitive comprehension to say that the collected shock force splits into its horizontal and vertical components according to a ratio that varies during the progress of the shock.

The best light on the points of practical interest is obtained, however, by letting down the theoretical bars a little and imagine that the wheel is not perfectly rigid but can yield and spring a little, as all wheels in practice do.

AT THE MOMENT OF IMPACT THE VEHICLE IS GOING FULL SPEED FORWARD AND CONTINUES TO DO SO, WHILE THE RISE OVER THE OBSTACLE MUST BE PRODUCED FROM REST. The rise cannot be instantaneous, as all the forces are finite. Its speed cannot at first be at all comparable to the forward speed of B. But this relative retardation immediately after the impact, as compared with the subsequent portions of the rise, is in conflict with the nature of curve BC, according to which the rise is relatively strongest at the beginning. And such a conflict can only mean that the force of the horizontal shock is made relatively stronger at that moment. If there is any yield in the wheel at all, the curve BC is buckled into the shape of B'C, Fig. 3, and the subsequent reaction throws the wheel slightly upward from the obstacle. Both the horizontal and the vertical shocks are then terminated in spaces of movement which are of about like extent, and the horizontal is determined by a mass and a velocity which are both higher than those determining the vertical shock.

"Is it fair," asks F., "to draw conclusions . . . in terms of work . . .?" M. C. K. thinks it is perfectly fair when there is question of work of considerable magnitude done in a small fraction of a second, and conditions are so complicated that the forces cannot be determined with accuracy because they depend upon exact knowledge of certain irregularities of movements, which perhaps could be eliminated in theory but in practice must alwayst be present.

M. C. K. does not pretend to have stated here, or to have stated before, exactly what MUST take place during a shock of the kind described, as this would require a strict demonstration, like that of Fellowcraft's but more elaborate and difficult and after all not conclusive for more than one condition. He did not feel that this was possible or profitable. And F.'s argument has settled this opinion, at first more vaguely entertained. An estimate in terms of work, on the other hand, supplies a frame within which the forces that determine the destructive effects may play differently according to the practical circumstances. In this sense the work values show what may take place. The forces may rise in pounds to the numerical magnitude of the foot-pounds in the work values, if the conditions cause the work to become condensed in an instant. And it is against these possibilities that springs are provided.

The majority of road shocks have but a small horizontal component—which, moreover, interferes little with comfort, being absorbed in the vehicle movement—and it must seem a doubtful expedient to interfere with the best action of the springs for the vertical component by combining them with springs which normally have little to do, if the combination is so intimate that they must always work together. Such a combination in practically a single spring—set for an average angle of import which must be too small for shocks with a large horizontal exponent and too large for the majority of shocks—must always be too hard for its normal work and too weak for the exceptional work for which it is mostly intended. M. C. K. therefore sticks to the belief that independently operating springs for the two shock components represent the construction problem to be solved for all motor vehicles operated with hard tires, while LARGE air tires may take care of the problem acceptably enough for the present, so far as the ordinary pleasure car is concerned.

European High-Efficiency Motors—Part II

(*Continued from page* 711)

of maximum lift and t the time during which the velocity increases from o to v_c, according to the known formula,

$$t \times j = v_c, \text{ or } j = v_c/t$$

The time t corresponds to the distance of A to B, or the angle $\beta = 22$ degrees of rotation of the cam, or

$$t = \frac{\beta}{\omega} = \frac{22}{12{,}000} = 0.00183 \text{ (see below).}$$

The maximum velocity of the lift is traced by the line C — C.

When the shaft revolves $\alpha = 38$ degrees, the cam lifts the valve e = 9.3 mm. The angular velocity per second of the cam is ω, or

$$\omega = 360 \times \frac{n}{60} = 360 \times \frac{2{,}000}{60} = 12{,}000 \text{ degrees per second.}$$

The velocity V_c becomes

$$V_c = \frac{\omega \times e}{\alpha} = \frac{12{,}000 \times 0.0093}{38} = 2.93 \text{ meters per second.}$$

We can also establish this value with the formula:

$$V_c = \sqrt{2 \times j \times S}$$

if we consider j constant; in reality this value is variable for the different points of the cam. If we take the values of the first of these formulæ, we obtain

$$j = \frac{C_c}{t} = \frac{2.93}{0.00183} = 1{,}600 \text{ m.p.s.}$$

The mass M_s and the acceleration j being determined, we can obtain according to the formula of the valve inertia

$$P_{is} = M_s \times j = 0.0119 \times 1{,}600 = 19 \text{ kilos (39 1-2 pounds).}$$

The effort of inertia P_{ip} of the pushrod becomes

$$P_{ip} = M_p \times j = \frac{Q_p}{g} \times j = \frac{0.55}{9.81} \times 1{,}600 = 8.95 \text{ kilos (19 1-2 pounds).}$$

The load P_s of the valve spring becomes

$$P_s = 1.4 \times P_{is} = 1.4 \times 19 = 27 \text{ kilos (59 1-2 pounds)}$$

and the load P_p of the pushrod spring

$$P_p = 1.4 \times P_{ip} = 1.4 \times 9 = 13 \text{ kilos (28 1-2 pounds).}$$

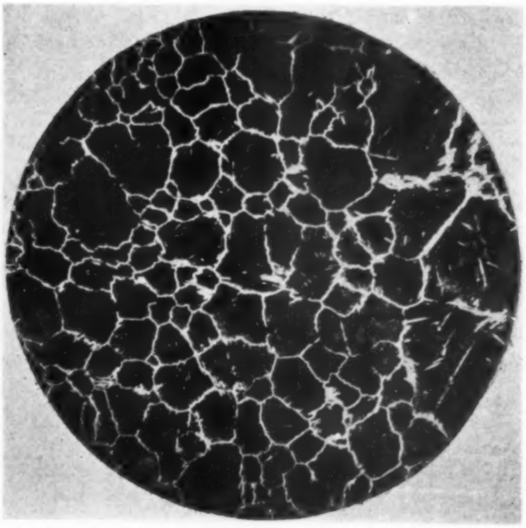
In order to facilitate the calculations we have used round figures in the preceding formulæ. The effort P on the cam at the moment of valve opening becomes:

$$P = P_s + P_p + P_{is} + P_{ip} = 27 + 13 + 19 + 9 = 68 \text{ kilos (150 pounds).}$$

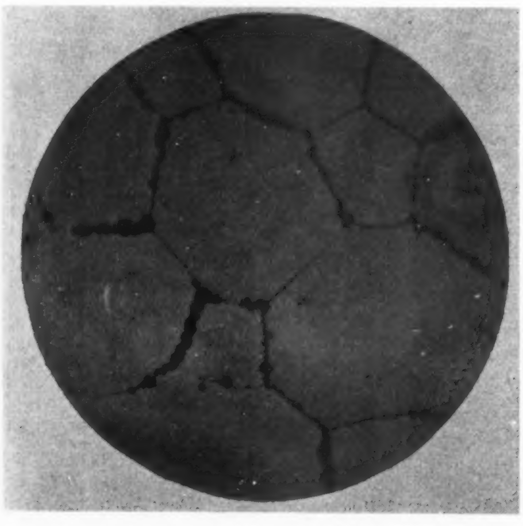
An effort of 150 pounds is therefore necessary in order to open the valve. If the motor is one which need not necessarily be silent, we can dispense with the valve tappet spring; in this case all that is necessary is to increase the valve spring by the amount of the tappet spring. If we are dealing with an exhaust valve which opens against pressure in the cylinder, it is not necessary to take this pressure into account, for it is only 20 kilos, while the acceleration at this particular moment is a low value.

(*Continued on page* 740)

Typical specimen showing Cementite and Martensite magnified 250 diameters. Here the needle-like characteristics of the glass hard Martensite are visible. The Cementite is the solid background.—W. Campbell



Cementite and Pearlite magnified to 60 diameters. The Cementite is visible in its characteristic thin line and the Pearlite is shown in the black areas throughout the section.—W. Campbell



Austenite and Troostite magnified 50 diameters. This steel is in the transitory stage from the Austenite towards the Ferrite and Cementite.—W. Campbell

STEEL—Its Pathology—Part III

(*Continued from page* 708)

have the properties that it possessed at the time it was at the definite temperature at which it was quenched. In other words, it can be kept nearer the Austenite.

There are two prime factors by which the heat treating of steel can be controlled. First, by the temperature to which the material is raised; and second, by the rate of cooling. After these primary considerations there are four secondary ones: The original chemical and physical properties of the metal which should have been correctly chosen; second, the composition of the substances with which the metal comes in contact during its period of heating and cooling; third, the length of time consumed in raising the material to its temperature; and fourth, the length of time the material is soaked, or, in other words, allowed to remain at its highest temperature.

With the large number of materials that the metallurgist has at his disposal to start with, the wide range of temperatures to which he may raise the steel, and the wide range of possibility throughout all the other variables mentioned in the preceding paragraph, there is little wonder that the hundreds of thousands of permutations and combinations produce fields of research which annually bring forth new and improved results.

Forging can be taken for a good example. The bar of stock from which the forging was made may have had a fairly good structure, but if the shock of the falling die struck this bar of stock when at a temperature lower than the critical its structure would become distorted, some of the crystals broken down and others reformed. If the temperature of the bar, however, was above the critical point, and the steel in an Austenitic condition when the die struck it, the resulting steel will be a fairly uniform formation of Austenite crystals. Although the original structure will have been changed, the forged piece will still have the characteristic Austenite. Thus it is seen that not only in heat treating is temperature of the greatest importance, but also the steel must be worked at the proper temperature.

Steel Worked in Austenitic Stage

As a general rule steel should be worked when it is in the Austenitic stage. It is then sure to keep a uniform structure because the carbon is in solid solution with the iron and is therefore distributed uniformly throughout the metal. If it is worked below the critical point, the carbon has begun to stratify and form different combinations and carbides with the result that uniformity is not apt to result. Just as soon as the temperature begins to fall below the critical point the Austenite begins to break up into Ferrite and Cementite. If the carbon content of the steel is high, Cementite will result, and if it is low the greater part will be composed of Ferrite.

By working the steel well above the critical temperature the size of the Austenite crystals is kept small and although on cooling the Austenite crystals will not remain in that form if they are finely divided, the size of the grains of the final result will be much smaller and hence a more uniform structure will result. A final steel will be composed of Pearlite; Ferrite and Pearlite; or Cementite and Pearlite, according to the carbon content. The higher the carbon content the greater percentage of Cementite, and therefore the harder the steel. It can always be remembered that the cause of the great effect of carbon on steel is due to the fact that it only takes 1 per cent. of carbon to form 15 per cent. of Cementite—the hard, brittle constituent of the high carbon steel.

The ultimate object is to secure a fine, uniform grain and this can be secured by not re-heating the metal to too high a temperature and by thoroughly rolling it or working it at a temperature well above its critical point. If this is correctly done the micro-photograph will show a fine, evenly-distributed grain which, in the case of carbon steel, will be composed of Ferrite and Pearlite. The Ferrite is light gray and the Pearlite has a black, stratified appearance on the micro-photograph; the percentage of carbon will determine the relative quantities of Ferrite and Pearlite, i.e., the lower the carbon, the more Ferrite.

Steel Can Be Worked Cold

Steel can be worked cold, as in the case of cold-rolled steel, but afterwards it must be annealed in order to remove the internal strains which

have resulted from the cold working. The annealing must be done above the critical point, i.e., at which the steel has been again raised to the Austenitic condition where the iron carbide is in solution, and on cooling a complete re-crystallization results. In annealing steel care must be taken that the exterior surface does not become oxidized, owing to the tendency of the metal to absorb oxygen while hot. When the surface becomes oxidized scale forms which peels off under slight stresses.

In annealing, if the temperature is too high the crystals of Austenite become large and on cooling a coarse-grain material will result. On the other hand, if the temperature is too low a complete reformation of the crystals and an elimination of internal strains will not be effected. On ordinary carbon steels the temperature of annealing is generally somewhere between 700 and 850 degrees Centigrade. The prescription that the doctor of steels has selected will effect the proper treatment and the annealing temperature will be less for one composition than for another.

Two results are desired from heat-treating: first, to bring the steel to its proper degree of hardness, and second, to bring the grain to a fine, even structure. As a general rule, the larger the percentage of Austenite that can be retained the harder will be the resulting metal and this is where the work of the alloys is important, because with ordinary carbon steel it is very difficult to retain very much of the Austenite after the steel has cooled to its ordinary temperatures. Martensite is an undesirable form often found in the carbon steel, being the next step below Austenite, and under the microscope it has a characteristic needle-like appearance. With the alloys such as nickel the Austenite is retained in the form of the grain which generally shows under the microscope as a polygonal structure which is of more or less fineness, depending on the result of the heat-treating. Martensite, while very hard, is very brittle, and when a steel consists entirely of Martensite, which would be the case with high-carbon, highly-hardened steel, it is practically useless. When such a steel is produced it must be re-heated at low temperatures and cooled quickly, but not suddenly, this process being known as tempering, and results in the furthering of the change from Austenite into Ferrite and Cementite. The final result will be either Troostite or Sorbite, and the lower along the scale the process is carried, the lower the hardness and brittleness and the higher the ductility.

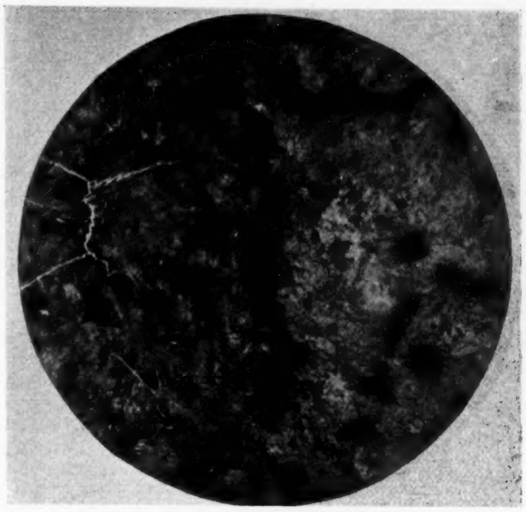
Alloy Steels Retain Hardness

The heat-treating of the alloy steels brings out the value of these alloys in allowing the metals to retain their hardness, and yet, when cooled, to have the normal fine-grained Pearlite and Austenite structures. These alloys such as nickel, manganese, chromium, vanadium and tungsten either form solid solutions with iron or form carbides which are valuable in producing the desired structural composition. Each of the alloys has a definite action which can be brought out under the influences of the heat-treatment.

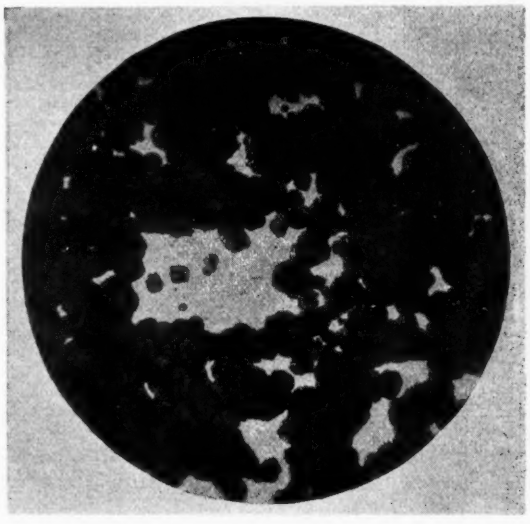
Nickel, probably the most useful of alloys for automobile work, is soluble in iron and has marked influences on the properties of a high-carbon steel. The higher the carbon the greater the effect of nickel. The 3.5 per cent. nickel steel most commonly used in automobile practice shows under the microscope a marked Pearlitic structure. This, as has been pointed out, is the result of the inter-stratifying of Ferrite and Cementite in the ratio of six parts of Ferrite to one of Cementite. The presence of the Cementite renders the steel hard, the presence of the Ferrite renders it ductile, and the combination is what generally results from the use of nickel in steel;—a hard metal with high elastic limit and great tensile strength. Higher percentages of nickel up to 15 per cent. produce Austenitic steels. Just between the Pearlitic and the Austenitic steels are the hard, brittle steels which are made up of Martensite. These are useless and care must be taken in the use of nickel not to strike the intermediate period between the Pearlite and the Austenite. The intermediate period is at about 7 per cent. nickel with a carbon content of .5 per cent. Here the Martensite exerts its properties and the result is a steel which probably would break if bent slightly and would have no elasticity whatever.

Manganese is the material which eliminates the ill-effects of sulphur to a large extent, resulting in the formation of a sulphide which does little harm to the structure. When manganese steel is slowly cooled the micro-photograph will show considerable carbide surrounding the typical grains of Martensite. If the steel is quenched suddenly at a temperature

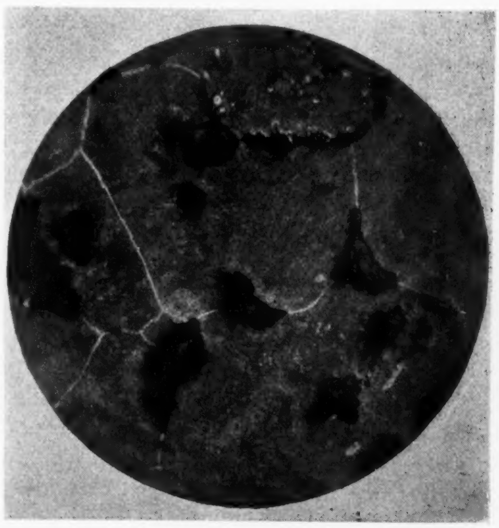
(*Continued on page* 740)



Troostite and Austenite magnified 50 diameters. The Austenite shows in the polygonal grains, whereas the Troostite is in the lake-like formations throughout the section.—W. Campbell



Graphite and Cementite magnified 60 diameters. The black masses of graphite are readily perceived interwoven through the background of gray Cementite.—W. Campbell



An example where the temperature in treatment was carried too high. Here is shown a piece of steel which has been burned, thereby creating the weak areas which are visible in the micro-photograph.—W. Campbell

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Bad Brakes Spell Death

WHEN the first few automobile builders came along they had their hands full with the task of producing a motor that would keep running and a transmission which would hold together. When they had expended the whole of their energies upon these essentials almost anything sufficed for the remainder. Hence, no doubt, the crude, comfortless and weird-looking bodies of the early days. Amongst the things which were left to the last were brakes; the manufacturer had too much trouble in making his car go to evince any great anxiety about stopping it, and there was as little to go on in brake designing as in motor making. In a horse vehicle you have motor and brake in one, so that the crudest of contrivances, which can aid the retarding effort of the animal, for centuries sufficed to fill the bill. For very many years the brakes on railroad trains were crude and inefficient—it was easy to stop a train slowly but impossible to bring it to rest quickly in emergency, and this cost the lives of thousands of people. Even after the air brake had been invented it was all too long before it came into general use; railroad men in all parts of the world were accustomed to the inefficient brake systems they had and resented change.

Today, the average automobile is in the same state as the poorly equipped railroad train existing *after* the discovery of the air brake. Not that there has been any special form of brake invented which makes all the difference to the automobile as did the Westinghouse brake to the train, but rather because while a select few have improved their brakes to keep pace with improved motors, the majority have brakes no better than ten years ago.

Let it not be forgotten that bad brakes are *death* to somebody sooner or later. If the automobiles of today had brakes as good as their motors there would be many living who have ceased to do so even since the dawning of 1915.

City Accidents

STATISTICS are useful as forming bases for deductions that point to possible improvements in practice, and viewed in this light the recent figures on fatal accidents in the streets in New York City prove that control of the pedestrians is practically as important as control of the vehicles in the prevention of accidents. Of the sixty-two persons killed by vehicular traffic on the streets of the city during the first 3 months of the present year twelve were not killed at street intersections but midway of intersections; in other words, crossing the streets at points where they are not supposed to do so.

Accidents are going to continue on the streets of our large cities, but they can be reduced by careful regulation of vehicular traffic and equally careful regulation of pedestrian traffic. You cannot secure the minimum of accidents by legislating for the regulation of either one; you must legislate sanely for both, at the same time, and with the regulations equally enforced. Our sidewalks carry signs telling where automobiles can be parked, in other cities are signs stating where street cars and buses stop, yet in none of these cities can you find signs which tell the pedestrians where they must cross the streets as well as where they must not cross them. A few conspicuous sidewalk signs defining the duties of pedestrians would accomplish a great deal and do much to reduce accidents.

When we enter street cars we face signs of Safety First; when we go to railroad depots we see safety signs; in short, we meet them in many places, yet strange that we never meet them at dangerous street intersections. Safety largely depends on instilling the safety habit in our pedestrians as well as in those driving vehicles. A few signs will aid vastly in impressing on the pedestrians what their duties are when crossing streets. Better still, if our traffic officers require that pedestrians be required to obey traffic laws to the same extent that vehicles are required to do so.

OUR roads are dotted on every fine day with cars held up with tire troubles, the old story of tires neglected during winter and then spoiling the spring trips. Take the tires off, take the tubes out, clean tubes off, clean out the casings, add new chalk, graphite the rims, and you will find that many of the early spring troubles will disappear. If your car has stood on the tires all winter you will have more trouble, a trouble that cannot be remedied by these directions.

Ford Production May Reach 325,000

Company Produces 2,096 Cars in 1 Day—A Record—1,300 of These Made in Detroit Plant

DETROIT, MICH., April 19—*Special Telegram*—In 1 day, on March 17, the Ford Motor Co. made 2,096 cars. It is a production record never before attained by any automobile manufacturer in the whole world. It is the average annual production of a great many car makers.

This record output represents the total of the cars built in the main plant in Highland Park and in the twenty-two assembling plants now in operation throughout the country. Probably 1,300 to 1,400 of the cars were made in Detroit.

To make this achievement possible the Ford officials say that no special arrangements were made but that it resulted from the gradual increase of the number of working men and the continual perfecting of the general working system throughout the plants. There were from 16,000 to 17,000 men on the payroll in Highland Park on that day and about 7,000 in the assembling plant. In the latter they are working 8 hours a day but in the big plant they are working 24 hours a day, in three shifts, each shift working 8 hours.

This immense output of automobiles for 1 day does not seem so extraordinary to the Ford company, whose officials said that the very next day after that record was made the output was 2,026, and on April 11 it was 2,011. From now on it will be steadily increased and within a few weeks an output of 3,000 or more a day will be recorded.

If all of the 2,096 cars made March 17 had been runabouts the total value for the day's output would have been $922,240. It required seven trains of fifty freight cars each to carry away the record breaking production, or a trainload an hour. All of the cars were shipped in 1 day.

Only about 2 years ago, May 28, 1913, the Ford company achieved the then considered extraordinary feat of building 1,000 cars in 1 day. June 17, 1909, for the first time 100 cars were made in one day at the Highland Park plant.

The production of the Ford company for the 365 days of 1905 was 401 cars less than what was made on that single day, March 17.

Instead of a total production of 300,000 cars for its fiscal year ending August 1, the Ford company will make at least 325,000 cars.

3,000 Shipped from Canadian Plant

FORD, ONT., April 15—Three thousand cars were shipped during March from the Canadian plant. Three thousand six hundred is the goal for the factory to reach during April, while every possible means of increasing the output is being employed. A rate of 150 cars per day has been reached by the factory and even this may be beaten. The March 29 week marked the largest output in the history of the company, and on Saturday, eighty-one cars were made by noon.

Canadian Ford Raises Pay—Cuts Hours

FORD, ONT., April 21—*Special*—All employees who have been in the service of the Ford Motor Co., Ltd., 6 months or longer are to receive a minimum wage of 50 cents an hour, or $4 a day, working hours being reduced to 8 hours a day, or 48 hours a week, according to an announcement made here today by G. M. McGregor, general manager.

This means an increase of 15 to 60 per cent. in the wage scale of the 2,400 employees of the company in Canada and it is estimated that about $600,000 a year will be distributed among them in addition to present wages.

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NEW YORK CITY, April 21—The Safety First Society of this city, as a result of the records of the board of coroners, has issued a report showing that during the first 3 months of the present year sixty persons were killed on the streets of the city by vehicular traffic, and that of this number forty-nine were killed at street intersections and twelve midway of the blocks or points of street intersection. There were twenty-one fatalities in January, seventeen in February and twenty-four in March.

An analysis shows forty-five killed by motor vehicles, including fire engines, motor buses, taxicabs, motor trucks and passenger cars. Six were killed by trolley, nine by horse vehicles, one by train and one by motorcycle. Further analysis shows that several deaths were due directly to the pedestrians who were not struck by the vehicles but walked into the rear wheels. There has been suggested the necessity of compelling guard rails along the side of vehicles to prevent people walking into the sides of vehicles, but general opinion is that pedestrians must be educated to look to the right or left when crossing a street. Several of the accidents were due to storms when umbrellas obscured the approaching vehicles.

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BOSTON, MASS., April 17—Medical Examiner J. B. Magrath, whose district embraces a large part of Suffolk County, which includes more than half of Boston, gave a few statistics on accidents at an automobile meeting this week, and ended by advising a campaign of education for children and parents. He said that in 1914 of the accidents reported to him that ended fatally in which vehicles were concerned there were sixty-three, due to steam, electric and horse-drawn vehicles, and twenty-two due to motor cars and cycles, a percentage of about 75 per cent. for the former and 25 per cent. for the motor-driven. The figures were thirty-four steam, fourteen electric and fifteen horse-drawn. He said that laws and ordinances would not be effective against children because they could not be enforced, and so it would mean educating them through the schools. He said the people had not realized the great change in the use of thoroughfares in the past 10 years, and it was time that there was an awakening.

S. A. E. Chain and Miscellaneous Standards Divisions Meet in Detroit

DETROIT, MICH., April 20—*Special Telegram*—Preliminary to the meeting of the standards committee of the Society of Automobile Engineers, which opens here on April 22, two sub-committees or divisions were in session today. These were the chain division and the miscellaneous division. Of the ten members of the miscellaneous division all but three were on hand, the absentees being C. W. Spicer, Berne Nadall and E. R. Whitney. The entire six members of the newly-formed chain division were present.

Today's deliberations of the miscellaneous division dealt principally with the standardization of speedometer drive-shaft ends and of cotter pin sizes. This cotter pin standardization seeks to cut down the number of needed sizes from some 200 to about forty-five. A table has been prepared giving a list of the recommended cotter pin sizes and also showing their applications to S. A. E. rod ends and bolts and U. S. bolts. As to speedometer drive ends the object is to arrive at some standard fitting which any manufacturer can order and be assured that any type of speedometer will fit it. This will enable any maker of flexible tubing to have a standard to go by. The division is getting out measurements for submission to manufacturers for criticism. In both of these matters the reports to the standards committee will be of progress.

The chain division is new and it is really just getting under way, sounding out the opinions and views of chain makers of this and foreign countries. Its report will be essentially one of progress.

No standard was up for final adoption today, all those considered being merely tentative for later submission to not only the standards committee but to the society as a whole, and to the manufacturers.

Tomorrow, April 21, the international standards, research and springs divisions will meet.

Busby, Duplex Governor Engineer, Dies

NEW YORK CITY, April 15—Lloyd G. Busby, chief sales engineer for the Duplex Engine Governor Co., New York City, died in Lima, O., April 17, while traveling. Funeral services will be held at 163 East Sixty-first street, New York City, Monday afternoon, April 26. Busby, who was 26 years old, was taken ill with pneumonia while in pursuit of his duties.

Overland Daily Output to Be 600

Expect 100% Increase in 1916—Before June 1 Additions to the Factory Will Be Finished

TOLEDO, O., April 19—Six hundred Overland cars a day will be the output of the Toledo factory during its next fiscal year. This statement was made by John N. Willys, president of the Willys-Overland Co., while in the West, where he has been spending the winter.

"By June 1 we will have finished additions to the Overland factory which will make it possible for us to turn out 600 cars a day," says Mr. Willys. "This will be our daily output next year.

"At the present time we are building 300 cars a day. The increase in this year's business is 30 per cent. over that of last year, when we built 48,468 Overlands. I fully expect that 1916 will see a 100 per cent. increase.

"The Toledo plant of the company covers 99 acres of ground. Its capacity has been doubled in the last 2 years. The new additions now in the course of construction will contain 17 acres of floor space, making a total floor area of 79 acres. The company employs 12,000 men."

Dunham Leaves Chalmers—Hinckley Promoted

DETROIT, MICH., April 16—George W. Dunham, second vice-president and consulting engineer of the Chalmers Motor Co., has relinquished his active duties with that company to become a consulting engineer at large with offices in Detroit, wherein he will have an opportunity to act in an advising capacity for any automobile manufacturer. C. C. Hinckley, who has been a Chalmers designing engineer, becomes consulting engineer of the Chalmers company to succeed Mr. Dunham.

Mr. Dunham has had a varied automobile experience, starting with the American Carriage Co. In 1904 he became engineer for the Oldsmobile company which position he held until 1909 when he became associated with the Hudson Motor Car Co. In 1910 he formed the Chalmers connection which he has just given up. Mr. Dunham will make a specialty of high speed motor work, having studied this type of design for several years.

Mr. Hinckley was first connected with the Covert Motor Vehicle Co., Lockport, N. Y., in an engineering capacity, later going with the Olds Motor Works as assistant to Mr. Dunham. He later became chief engineer of the Oldsmobile concern when Mr. Dunham left it to go with the Hudson company. Mr. Hinckley came to the Chalmers company in 1912.

MADISON, WIS., April 15—Up to April 10, applications for automobile licenses in this state numbered 42,000, averaging about 1,000 a day. The record for a day is 1,700. Last year 53,161 licenses were issued. The annual increase has been about 55 per cent.

SAUK CITY, WIS., April 15—A. L. Aldrich, second vice-president of the Shaw Motor Co., this city, has been promoted to the first vice-presidency. The concern recently established permanent works at Sauk City, removing to that place from Chicago.

Madison Motors Co. Is Incorporated

INDIANAPOLIS, IND., April 17—The Madison Motors Co., with plants at Anderson, was incorporated on Thursday for $500,000, as announced in THE AUTOMOBILE for April 1. The principal stockholder is C. E. Gibson, former treasurer of the Gibson Automobile Co., this city, and part owner of the Empire Automobile Co. Associated with Gibson and named as directors are W. E. Moore and O. R. Ewing.

At present the company will concentrate its efforts on a six-cylinder car equipped with a Rutenber motor. The body of the new car is of the streamline type. The car has a 118-inch wheelbase and is equipped with Remy starting, lighting and ignition device.

A light four-cylinder car of substantial build and low-priced is now being finished and within a short time will be ready for the market. The six-cylinder will be produced first, however.

Pampell Heads Lyons-Atlas Co.

INDIANAPOLIS, IND., April 16—E. H. Pampell is the new president of the Lyons-Atlas Co., succeeding J. W. Lyons. Mr. Pampell represents interests of great importance in the Lyons-Atlas concern.

$500,000 Goodrich Factory Addition

AKRON, O., April 15—The B. F. Goodrich Co. will build an addition costing around $500,000, work on which will be started this summer. This will probably mean the employment of several hundred more men by the company which is now running at full capacity. Recently the company bought at public sale a strip of land adjoining the canal in the rear of the present factories. The factory will be built on this land.

New Head for Pullman Company

YORK, PA., April 20—Edward K. Fox, this city, was made the president of the Pullman Motor Car Co., at a reorganization meeting held in this city yesterday. Mr. Fox fills the vacancy caused through the resignation of Thomas C. O'Connor, New York, which occurred last fall. The new president, it is said, has purchased the controlling stock of Mr. O'Connor and R. N. Cook, also of New York City.

At a reorganization of the company last June, R. N. Cook was made vice-president and since that time he has acted in the capacity of president.

To Confer on S. A. Business Conditions

WASHINGTON, D. C., April 17—American manufacturers desirous of extending their trade in the Central and South American republics will be interested in the proceedings of the conference of ministers of finance and bankers of all the American countries, which opens here May 21. The purpose of the conference will be consideration of relationships, especially in the realm of business and finance, among the countries of the western hemisphere.

It is now assured, by reason of the high character of the personnel that will make up the gathering that the conference

Market Reports for the Week

NEW YORK CITY, April 21—The metal markets this week were more or less prominent as a result of the numerous price changes. Tin this week was lower, due to the arrival at Boston of three steamships with 1,650 tons, which will later come to this city. This metal went down to $46.00 per 100 pounds at a loss of $10.00 Copper was strong throughout the week and reached a new high mark in prices. Electrolytic copper closed at $0.17 1-4 and Lake at $0.18. Antimony this week was firm and at the closing on Tuesday went up 1 cent a pound. Beams and channels on Thursday rose 5 cents and remained at that rise throughout the week, closing at $1.31. No changes occurred in the oils and lubricants markets, which have been very steady during the past 3 weeks. Fine Up-River Para went up 1 cent on Tuesday. Trading continued light, manufacturers restricting their purchases as a rule to small parcels for prompt use.

Material	Wed.	Thurs.	Fri.	Sat.	Mon.	Tues.	Week's Changes
Antimony	.21½	.21½	.21½	.21½	.21½	.22½	+.01
Beams & Channels, 100 lbs.	1.26	1.31	1.31	1.31	1.31	1.31	+.05
Bessemer Steel, ton	18.00	19.00	19.00	19.00	19.00	19.00	+1.00
Copper, Elec., lb.	.16⅜	.16⅝	.16¾	.16⅞	.17¼	.17¼	+.00⅞
Copper, Lake, lb.	.16½	.16¾	.17	.17	.18	.18	+.01½
Cottonseed Oil, bbl	6.54	6.40	6.40	6.48	6.60	6.65	+.11
Cyanide Potash, lb.	.21	.21	.21	.21	.19	.21	......
Fish Oil, Menhaden, Brown	.41	.41	.41	.41	41	.41	......
Gasoline, Auto, bbl.	.12	.12	.12	.12	.12	.12	......
Lard Oil, prime	92	.92	.92	.92	.92	.92	......
Lead, 100 lbs.	4.17½	4.17½	4.17½	4.17½	4.17½	4.17½	......
Linseed Oil	.62	.62	.62	.62	.62	.62	......
Open-Hearth Steel, ton	18.50	19.00	19.00	19.00	19.00	19.00	+.50
Petroleum, bbl., Kans., crude	.40	.40	.40	.40	.40	.40	......
Petroleum, bbl., Pa., crude	1.35	1.35	1.35	1.35	1.35	1.35	......
Rapeseed Oil, refined	..	..	..	..	..	..	......
Rubber, Fine Up-River, Para	.60	.60	.60	.60	.60	.61	+.01
Silk, raw, Ital	..	3.90	..	..	3.90	3.90	......
Silk, raw, Japan	..	3.52½	..	..	3.52½	3.50	—.02½
Sulphuric Acid, 60 Baume	.90	.90	.90	.90	.90	.90	......
Tin, 100 lb.	56.00	54.00	52.00	50.00	50.00	46.00	—10.00
Tire Scrap	.04¾	.04¾	.04¾	.04¾	.04¾	.04¾	......

will be one of the most practical and important ever held in which the agents of governments have come together. It is rumored that a highly ambitious plan contemplating the establishment of a great bank of the Americas would be presented to the conference, but if such a plan is in contemplation, government officials here are not prepared to admit it.

Thus far sixteen of the American nations have accepted the invitation of this government and it is understood that the balance will name embassies within a few days.

Norwalk Plant Sale on April 24

MARTINSBURG, W. VA., April 15—A public sale of the property of the Norwalk Motor Car Co., this city, will be made on April 24, according to an order issued by trustee in bankruptcy C. E. Martin. The property consists of a two-story brick building, the main factory, 40 by 100 feet in size; office furniture, machinery and tools; two Model E Norwalk cars and one model F, light six.

NEW YORK CITY, April 20—The Bankers' Trust Co., as trustees for the 10-year sinking fund gold bonds of the Locomobile Co. of America, is inviting proposals for the sale to it of bonds bearing coupons maturing subsequent to June 1 next at prices not to exceed 105 per cent. of the value of the bonds. Bids will be received up to May 26 at noon.

Dividends Declared

The following dividends have been declared:

Paige-Detroit Motor Car Co., Detroit, Mich., monthly increased from 4 to 7 per cent.

Lozier Motor Co., Detroit, Mich., 10 per cent. to creditors of old company. Sent out by Detroit Trust Co.

American Voiturette Co., Detroit, Mich., 10 per cent. to creditors.

U. S. Should Protect American Trademarks

WASHINGTON, D. C., April 17—More than ordinary interest attaches to an interview given out by Assistant Commissioner of Patents James T. Newton, in which he expressed the opinion that strong efforts should be made to bring about a change in the present situation which permits American trademarks to be registered in South American countries for the purpose of preventing American merchants from importing their goods into those countries. Involving the foreign relations of the United States, as the matter does, Commissioner of Patents Ewing said that whatever actual steps were taken would have to be taken through the State Department or through the Pan-American Union.

Unscrupulous Persons Profit

"There is no doubt that in a number of cases American merchants have been held up by unscrupulous persons in some of the South American countries, and also in some of the countries of Europe, who have registered the American trademarks in their own countries," said Assistant Commissioner Newton. "Under the American law the man who first uses a trademark is entitled to it and to registration of that trademark. In the South American countries and in Germany and some other countries of Europe the first person who registers a trademark with the officials of those countries is entitled to the trademark.

"You can readily see what an opportunity such a system offers to the unscrupulous. A person in a South American country, having registered the trademark of a well-known American brand, can absolutely prevent the importation of those goods into the South American country unless the American merchant is willing to come to terms with him, first paying him a round sum."

Automobile Securities Quotations

NEW YORK CITY, April 19—Automobile security prices received their first reversal today after an advance, more or less steady, which began in the last week of March. And furthermore, the decline came after a record-breaking trading day, when over 1,500,000 shares in all stocks were dealt in, thereby making a record for activity since September, 1911.

Gains were few and small while the drops were in some cases extraordinary; for instance, General Motors preferred with a decline of 20 points and the common with an 8 3-4-point loss, and the drops in the preferred stocks of a few of the tire issues which, heretofore, have shown unusual strength and activity.

There were a few gains made on stocks, however, which have up to this date been inactive, notably, the 6-point rise of Packard common and the 3-point gain of International Motors. The latter stock during the last few weeks has shown exceptional activity on account of large war orders, and the issue has correspondingly risen. Stewart-Warner rose this week to 68 at a gain of 10 points. Texas Oil rose 4 points. J. I. Case preferred was a little more active this week, closing at 78 with a gain of 3 points.

Security prices in the Detroit exchange experienced a sympathetic reversal. Though some of the stocks rose, the gains were smaller than usual while the declines, which heretofore have been few and small, were much larger, ranging from 1 to 6 points. No changes occurred in the inactive stocks.

	1914		1915		Week's
	Bid	Asked	Bid	Asked	Ch'ges
Ajax-Grieb Rubber Co. com	200	..	285	..	..
Ajax-Grieb Rubber Co. pfd	99	102	100	..	..
Aluminum Castings pfd	98	100	98	100	..
J. I. Case pfd	..	..	78	87	+3
Chalmers Motor Company com	80	82½	93	98	—1
Chalmers Motor Company pfd	89	91	92	94	..
Electric Storage Battery Co	49½	50	51¾	52½	+1¾
Firestone Tire & Rubber Co. com	284	290	455	460	..
Firestone Tire & Rubber Co. pfd	107½	109	110	112	..
General Motors Company com	81½	82	136	138	—8¾
General Motors Company pfd	92	92½	99	101	—20
B. F. Goodrich Company com	27	28	46	47	—5¼
B. F. Goodrich Company pfd	88	89½	101½	102½	—1
Goodyear Tire & Rubber Co. com	165	170	238	244	—2
Goodyear Tire & Rubber Co. pfd	95	96	104½	105½	+ ½
Gray & Davis Inc. pfd	90	97	..	..	..
International Motor Co. com	..	5	17½	19½	+3
International Motor Co. pfd	..	15	32	35	..
Kelly-Springfield Tire Co. com	..	..	134	135	—4
Kelly-Springfield Tire Co. 1st pfd	..	..	84	85	..
Kelly-Springfield Tire Co. 2d pfd	..	..	134	140	—3
Maxwell Motor Company com	8	8½	47	49	+1
Maxwell Motor Company 1st pfd	32	33	81	83	—3
Maxwell Motor Company 2nd pfd	12	12½	36½	38	—2¾
Miller Rubber Company com	..	..	185	190	..
Miller Rubber Company pfd	..	..	101	103	..
New Departure Mfg. Co. com	..	..	..	..	..
New Departure Mfg. Co. pfd	..	..	..	..	..
Packard Motor Car Co. com	103	..	86	..	+6
Packard Motor Car Co. pfd	94	98	93	..	—1
Peerless Motor Car Co. com	15	..	20	21	..
Peerless Motor Car Co. pfd	..	75	..	55	..
Portage Rubber Co. com	..	25	34	36	..
Portage Rubber Co. pfd	..	75	85	95	..
*Reo Motor Truck Company	7¾	8¾	14¾	15¼	+1¼
*Reo Motor Car Company	19¾	20¾	33½	34½	+1
Splitdorf Electric Co. pfd	40	50	..	..	..
Stewart-Warner Speed. Corp. com	55	59	68	70	+10
Stewart-Warner Speed. Corp. pfd	99	101	103	105	+1
Studebaker Corporation com	32	33	63	65	—3½
Studebaker Corporation pfd	85	86½	99	101	— ½
Swinehart Tire & Rubber Co	60	65	96	95	..
Texas Company	139	140	142	144	+4
U. S. Rubber Co. com	58	60	69	71	—3¼
U. S. Rubber Co. pfd	101½	102	107	109	—1
Vacuum Oil Co	212	216	208	210	..
White Co. pfd	97	100	103	108	..
Willys-Overland Co. com	64	66	125	128	—4½
Willys-Overland Co. pfd	89	94	100	101	— ½

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

Chalmers Motor Co. com	..	82	93½	94¼	+ ¾
Chalmers Motor Co. pfd	..	91	93	96	+1
Continental Motor Co. com	150	..	175	187½	+8½
Continental Motor Co. pfd	..	80	80	85½	+1½
General Motors Co. com	78½	80½	143	145	—1
General Motors Co. pfd	91	93	101	103	—4
Maxwell Motor Co. com	8¼	8¾	51	52½	+5
Maxwell Motor Co. 1st pfd	32	34	82	84	—2
Maxwell Motor Co. 2d pfd	12	12¾	39	40½	— ½
Packard Motor Car Co. com	103	..	80	..	—6
Packard Motor Car Co. pfd	94	98	93¾	..	— ¼
*Reo Motor Car Co	20¾	21¾	32¾	33¾	+ ¼
*Reo Motor Truck Co	8½	9½	14¼	15¼	+1¼
Studebaker Corporation com	..	..	65	67	—1½
Studebaker Corporation pfd	..	..	99	101	—2

INACTIVE STOCKS

*Atlas Drop Forge Co	..	21	..	26	..
Ford Motor Co. of Canada	..	560	600	..	..
Kelsey Wheel Co	195	..	190	200	..
*W. K. Pruden Co	..	21	19¼	21	..
Regal Motor Car Co. pfd	..	40	12	20	..

BONDS

General Motors, notes, 6s, 1915	101	102	..	..	..
Packard Motor Co. 5s, 1916	95	98½	..	..	..

*Par value $10; all others $100 par value.

Great Britain Again Our Largest Buyer

Purchases 4,913 Cars During Last 8 Months—During February Last 1,183 Cars Shipped There—Total Amounts to $5,372,788

WASHINGTON, D. C., April 16—Detailed figures showing the exports of automobiles and parts during various periods were made public today by the bureau of statistics. According to the official returns the United Kingdom still remains the best customer for American cars. During February last 1,183 cars of all kinds, valued at $1,688,313, were shipped there, as against 1,269 cars, valued at $1,017,594, exported in February a year ago. During the 8 months' period ended February, 4,913 cars, valued at $3,904,239, were exported in 1914, as against 4,631 cars, valued at $6,447,015, shipped to the United Kingdom in 1915. The big increase in the value of the exports is due to the large shipments of motor trucks made in the last few months.

France's imports of American cars during February last amounted to 412 cars, valued at $1,389,599, while in February a year ago the number was seventy-two and the value $49,011. During the 8 months' period the shipments of cars to that country rose from 536, valued at $410,814, in 1914, to 2,436, valued at $6,407,087, in 1915.

There were no shipments of cars to Germany in February last, while in February, 1914, the number was 108 and the value $79,600. The exports during the 8 months' period dropped from 590, valued at $413,144, in 1914, to sixteen, valued at $17,364, in 1915.

Italy's imports of American cars numbered sixteen, both in February last and the corresponding month of 1914, but the value decreased from $12,434 in February, 1914, to $11,390 in February last. During the 8 months' period the shipments decreased from 211, valued at $150,144, in 1914, to 42, valued at $35,112, in 1915.

Under the heading "Other European Countries" the exports amounted to 262 cars, valued at $193,736, in February,

Exports and Imports of Automobiles, Trucks, Parts and Tires for February and Preceding 8 Months

	February				8 months ending February			
	1914		1915		1914		1915	
EXPORTS	Number	Value	Number	Value	Number	Value	Number	Value
Automobiles:								
Commercial	57	$83,461	1,002	$3,022,482	493	$797,722	4,974	$14,011,924
Passenger	2,837	2,378,494	2,230	1,785,330	16,390	14,919,087	9,134	7,593,429
Total	2,894	$2,461,955	3,232	$4,807,812	16,883	$15,716,809	14,108	$21,605,353
Parts of (not including engines and tires)	.....	612,813	.....	564,976	.....	4,222,301	.....	3,354,222
Total automobiles, and parts of	.....	$3,074,768	.....	$5,372,788	.....	$19,939,110	.....	$24,959,575
BY COUNTRIES								
Cars, carriages, etc.: Automobiles:								
France	72	$49,011	412	$1,389,599	536	$410,814	2,436	$6,407,087
Germany	108	79,600	.....	.....	590	413,144	16	17,364
Italy	16	12,434	16	11,390	211	150,144	42	35,112
United Kingdom	1,269	1,017,594	1,183	1,688,313	4,913	3,904,239	4,631	6,447,015
Other Europe	262	193,736	131	406,368	1,151	906,827	832	2,300,646
Canada	292	361,895	349	345,733	2,055	2,940,057	1,727	2,236,426
Mexico	9	10,071	10	6,347	133	217,528	49	54,774
West Indies and Bermuda	33	35,854	183	98,630	372	348,599	651	439,642
South America	115	88,244	132	66,767	1,463	1,500,584	603	337,452
British Oceania	374	320,195	526	451,706	2,516	2,166,771	1,880	1,536,591
Asia and other Oceania	199	180,509	131	197,433	1,468	1,432,323	814	1,443,677
Other countries	140	112,812	159	145,526	1,475	1,325,779	427	349,567
Total	2,894	$2,461,955	3,232	$4,807,812	16,883	$15,716,809	14,108	$21,605,353
Tires for automobiles:								
Belgium	.....	.....	.....	.....	.....	$15,429	.....	.....
France	.....	.....	.....	.....	.....	.....	.....	$6,090
Germany	.....	$11,240	.....	.....	.....	70,534	.....	.....
England	.....	55,355	.....	$189,481	.....	859,990	.....	1,081,141
Canada	.....	48,767	.....	56,326	.....	508,485	.....	414,392
Mexico	.....	5,691	.....	4,161	.....	93,953	.....	65,017
Philippine Islands	.....	6,358	.....	32,086	.....	100,520	.....	157,247
Other countries	.....	41,763	.....	69,492	.....	402,944	.....	536,216
Total	.....	$169,174	.....	$351,546	.....	$2,051,855	.....	$2,260,103
IMPORTS								
Automobiles	9	$20,575	8	$9,061	230	$529,359	227	$376,916
Parts of (except tires)	.....	42,018	.....	29,958	.....	397,802	.....	566,913
Total automobiles, and parts of	.....	$62,593	.....	$39,019	.....	$927,161	.....	$943,829
BY COUNTRIES								
Automobiles:								
France	4	$8,829	2	$4,158	103	$257,592	38	$91,011
Germany	.....	.....	.....	.....	15	37,307	6	13,606
Italy	.....	.....	.....	.....	39	58,666	90	94,920
United Kingdom	2	4,546	4	3,903	36	110,222	57	137,356
Other countries	3	7,200	2	1,000	37	65,572	36	40,023
Total	9	$20,575	8	$9,061	230	$529,359	227	$376,916
India rubber, crude:	Lbs.		Lbs.		Lbs.		Lbs.	
Belgium	1,097,669	$629,244	.....	.....	5,973,501	$3,556,693	1,902,370	$950,872
France	513,615	189,149	33,675	$17,067	1,677,818	680,131	612,889	257,033
Germany	853,934	427,900	.....	.....	4,332,184	2,199,235	732,118	358,088
Portugal	4,514	1,724	.....	.....	31,594	10,310	1,798,119	538,996
United Kingdom	4,098,605	2,411,875	10,581,465	5,345,432	28,286,917	19,038,286	35,849,563	18,329,034
Central American States and British Honduras	29,958	20,045	67,782	35,051	388,281	214,916	389,607	168,540
Mexico	21,114	14,139	43,455	19,225	449,514	235,737	1,284,872	487,497
Brazil	2,129,616	841,273	3,483,244	1,411,623	23,038,882	9,355,071	30,175,069	12,406,174
Other South America	20,132	5,985	343,127	173,039	894,498	470,064	2,465,507	1,095,371
East Indies	1,279,270	697,326	26,420	11,816	8,008,173	5,016,326	12,746,417	6,147,760
Other countries	195,471	111,145	898,485	580,484	1,255,089	713,407	2,524,529	1,546,102
Total	10,243,898	$5,349,805	15,477,653	$7,593,737	74,336,451	$41,490,176	90,481,060	$42,285,467

1914, and to 131 cars, valued at $406,368, in February last, while during the 8 months' period the figures were 1,151 cars, valued at $906,827, in 1914, and 832 cars, valued at $2,300,646, in 1915.

Three hundred and forty-nine cars were exported to Canada in February last, the value being $345,733, while in February a year ago the number was 292 and the value $361,895. During the 8 months' period the exports decreased from 2,055 cars, valued at $2,940,057, in 1914, to 1,727, valued at $2,236,426, in 1915.

War-ridden Mexico imported nine American cars in February, 1914, the value being $10,071, and ten cars in February last, the value of which was $6,347. During the 8 months' period the imports decreased from 133, valued at $217,528, in 1914, to forty-nine, valued at $54,774, in 1915.

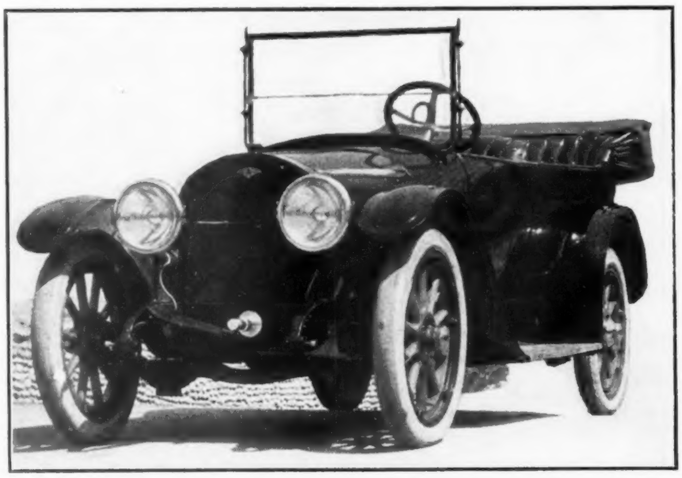
Exports of cars to British Oceania showed a healthy increase during the month's period, the number increasing from 374, valued at $320,195, in February, 1914, to 526, valued at $451,706, in February last. However, during the 8 months' period the shipments declined from 2,516, valued at $2,166,771, in 1914, to 1,880, valued at $1,536,591, in 1915.

BUFFALO, N. Y., April 17—It is expected that the United States Light & Heating Co. will emerge from receivership about the middle of May. Bankers who are interested in the affairs of the company are strongly recommending that holders of the old securities pay their assessment of $15 on the preferred stock and $2.50 on the common and take securities of the new company in accordance with the provisions of the plan for reorganization.

The bankers report that the earnings of the company at present are in excess of interest obligations on securities of the new company, and the outlook is said to be more favorable than for some time.

NEW YORK CITY, April 19—At a meeting of the Mayor's Central Committee on Street Traffic held at Police Headquarters, this city, today, action was taken which will bring about a conference between the committee and opposed interests on Wednesday, April 28. The meeting was in the nature of a public hearing and several speakers expressed opposition to an ordinance which they believed to be in contemplation limiting the length of vehicles using the streets to 24 feet 6 inches, the height to 12 feet 2 inches and the width to 7 feet 6 inches and the weight to 28,000 pounds.

Arguments were heard from representatives of the Motor Truck Club, Society of Automobile Engineers, the Traffic Committee of the Bronx Board of Trade, Automobile Trade Assn., Electric Vehicle Assn. of America, the Traffic Board of the Merchants Assn., a coal merchant, the Knox Motors Co., and the New York Van Owners' Assn.



The new Abbott-Detroit eight-cylinder model now being built by the Consolidated Car Co., Detroit, Mich., which took over the assets of the Abbott Motor Car Co. some time ago. As stated in a previous issue, the Abbott eight uses a Herschell-Spillman eight-cylinder, 3 by 5 V-type engine in which the two blocks of cylinders are offset from one another, allowing the connecting-rods to be placed side by side on the crankshaft. The chassis is practically the same as that formerly carrying the Model F name, which was a four-cylinder design. It has 121-inch wheelbase, floating rear axle, dry-disk clutch, left drive and center control, three-speed Warner gearset, Remy ignition, Zenith carbureter and Stewart vacuum fuel feed. A clean-cut streamline type of body is fitted, which does credit to the car. First shipments of this model are said to have been made last week.

Austin Injunction Modified

Cadillac Co. May Use, Repair and Resell Its Cars Having Two-Speed Axle—May Furnish Parts

CINCINNATI, O., April 16—Upon motion of the Cadillac Motor Car Co., Detroit, Mich., the United States Circuit court of appeals has modified the injunction which Walter S. Austin, of the Austin Automobile Co., Grand Rapids, Mich., obtained last year against the Detroit manufacturer in his suit for patent infringement covering the construction of two-speed axles.

The modified injunction permits the Cadillac company to use, repair and resell its cars having the two-speed axle, and to furnish parts or repairs for such cars, but does not allow the company to make or sell new cars with that type of axle.

It was also decided that the appeal of the Cadillac company against the decision rendered against it in this case by Judge C. W. Sessions, in Grand Rapids, Mich., in January, will be heard before the circuit court at the second week of the June session.

Cannot Fix Re-sale Prices

DETROIT, MICH., April 15—Re-sale prices cannot be fixed, according to a decision filed here in favor of the Government in its suit against the Kellogg Toasted Corn Flakes Co.

The Government attacked the selling plan of the defendant company, stating that it fixed the price at which its product should be sold from the manufacturer to the jobber, from the jobber to the wholesaler, from the wholesaler to the retailer, and from the retailer to the consumer.

On the ground that it held a patent on the carton in which its product was packed and that this patent gave it the right to fix the price of its goods, the Kellogg company filed a motion to dismiss the Government's petition. This motion was denied in the United States circuit court of appeals.

Can Re-open Patent Cases

WASHINGTON. D. C., April 19—By dismissal last week for want of jurisdiction of the case of E. L. Chott against Thomas Ewing, commissioner of patents, the United States Supreme Court left in force a ruling of the Court of Appeals of the District which in effect recognizes the right of the commissioner to re-open a case and reverse it after decision by the board of examiners of the patent office.

The case arose out of the application of Chott for letters patent on alleged improved dental broach holders. After the board of examiners had reversed the decision of the preliminary examiner that the alleged improvement was old, Commissioner Ewing re-opened the case, made a personal examination, and upheld the primary examiner.

Nebraska Has New Automobile Law

LINCOLN, NEB., April 17—Sweeping changes in the automobile license and registration laws are made in a bill passed recently by the senate and signed by the governor this week.

Automobile registration is placed under the state board of irrigation and public highways. The registration fees are to be paid to the county treasurer of the county in which the car owner or dealer resides.

Motorcycles are assessed $2 annually, automobiles operated for private purposes, $3 annually, and machines in commercial use, or offered for public hire, are charged $5 per annum. Every dealer in motor vehicles is required to pay a tax of $5 for each class of machine in which he deals.

Of the amounts paid, $1.50 of each $2 license, $2 of each $3 license, and $4 of each $5 fee is retained by the county treasurer and applied to the road fund, to be used for road dragging, etc. The balance is to be turned over to the state highway board for the state road fund.

ALBANY, N. Y., April 20—The Senate last night passed the Spring bill, abolishing the Labor Department and the Workmen's Compensation Commission and substituting an Industrial Board of five members to take over the functions of both. It is said the measure will save the state $227,000 annually. The bill now goes to the Assembly for concurrence.

Working on Sheepshead Bay Track

200 Men Clearing Ground—Wood Track Foundation Will Be Started May 1—Width 70 Ft.

NEW YORK CITY, April 21—Work started on April 17 on the new Sheepshead Bay 2-mile motor speedway in this city, and already over 200 men are taking down the various buildings and getting the ground cleared away. It is expected that the foundation of the track will be started by May 1 and the contract with the builder of the tracks and grandstands specifies August 20 as the date when these must be completed. As yet no date has been selected for the opening race. The track is to be of wood construction, and will be 70 feet wide on the straightaways and approximately 76 feet on the curves. The wood used is long leaf, yellow pine in 2 by 4-inch pieces laid on edge and running circumferentially or in the same direction as the line of travel of the cars when racing. These planks vary in length, namely 12, 14, 16, 18 and 20 feet, so as to give lap-jointing everywhere. The planks are soaked in creosote and the track will have a dark brown appearance. The banking is such that at the curves the outer edge is 25 feet 6 inches above the ground, the claim being made that the banking will permit of a higher speed than Brooklands track. A cross section of the track on the curves follows a parabolic curve, this being the same scheme as employed on Brooklands.

On the straightaways of either side, which are practically 1-2-mile long each, the track is supported on transverse concrete walls 6 feet apart and on the curves it is supported by steel frame work.

Safety precautions are being looked after in every respect. There will be a 30-inch wall of 8-inch concrete around the entire outside of the track and a similar wall at the inside. Between these cement walls and the spectators wide safety zones are arranged for. The grandstand will have accommodations for 30,000 and will be of steel with a double deck, and located directly opposite the repair pits. Diametrically across on the back stretch will be the bleacher grandstand with a capacity of 25,000. Special facilities are arranged so that there will be no delay in motorists entering or leaving the track.

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22 Entries to Date for Indianapolis

INDIANAPOLIS, IND., April 17—The recent entries of three Peugeots to be driven by Resta, Burman and probably Duray, has brought the list for the Indianapolis 500-mile race on May 29, up to twenty-two.

The Peugeots this year will represent two entirely different classes of motor construction. Resta's car is one of the trio that competed in the last French Grand Prix. Measuring 274 cubic inches, of the long-stroke type, it is said to be very speedy. The other two are smaller cars, like the one Duray drove last year. The list of entries to date follows:

CAR	DRIVER	ENTRANT
Stutz	Wilcox	Stutz Co.
Stutz	Anderson	Stutz Co.
Stutz	Cooper	Stutz Co.
Bugatti	Oldfield	George Fuller
Delage	De Palma	W. E. Wilson
Porter-Knight	Hughes	F. R. Porter
Porter-Knight	Whalen	F. R. Porter
Porter-Knight	Keene	F. R. Porter
Cornelian	Chevrolet	Blood Bros. Machine Co.
Sunbeam	Chassagne	Sunbeam Co.
Sunbeam	Porporato	Sunbeam Co.
Duesenberg	O'Donnell	Duesenberg Co.
Duesenberg	Alley	Duesenberg Co.
Maxwell	Rickenbacher	Maxwell Co.
Maxwell	Carlson	Maxwell Co.
Mercedes	De Palma	E. C. Patterson
Not named	Bergdoll	Erwin Bergdoll
Not named	Not named	Erwin Bergdoll
Not named	Not named	Erwin Bergdoll
Peugeot	Resta	Peugeot Co.
Peugeot	Burman	Peugeot Co.
Peugeot	Duray	Peugeot Co.

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Overland Wins Oklahoma City Race

OKLAHOMA CITY, OKLA., April 20—*Special Telegram*—The curtain raiser of the 3-days' road race meet being held here this week by the Southwest Auto Racing Assn. on the 2.409-mile course was won by an Overland which negotiated the 99 miles in 2 hours 2 minutes and 3 1-2 seconds, a speed of a little over 49 1-2 miles an hour. This was over a bad course with soft dirt and deep holes. The curves were particularly rough with the asphalt straightaways fairly smooth. Today's attendance was about 10,000.

On Saturday a 200-mile road race for a purse of $5,000 with a $1,000 bonus for the world's record car, will be run over the same course. The entries include Oldfield, Carlson, Disbrow, Hearne, Burman and Cooper.

The summary:

99-MILE OKLAHOMA ROAD RACE—$1,000 PURSE

Car	Driver	Time
Overland	Claude Foster	2-2-3 1-2
Hupmobile	R. W. Thomas	2-2-34
Studebaker	C. S. Shaffstall	2-5-5
Buick	C. B. Chandler	Time not taken

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Wheeler to Head Twin City Speedway Co.

ST. PAUL, MINN., April 17—F. W. Wheeler of Indianapolis, is scheduled to be elected president of the Twin City Motor Speedway Co. He will take a 25 per cent. interest in the company, which will soon begin work on a site comprising 360 acres located on the city limit line, 1-2-mile south of Minnehaha Falls, adjacent to the soldiers' home, at a cost of $1,000,000.

Makers Show Little Interest in Exposition

SAN FRANCISCO, CAL., April 13—Not a few automobilists are expressing disappointment at the exhibit of automobiles in the Panama-Pacific International Exposition here. Although there is a goodly representation of leading makers with plenty of space for exhibits, the exhibit is not by any means completely representative of the industry, and while some makers have too much space others have not enough. There is no effort at uniformity in the general scheme of decoration and apparently some makers are trying to dominate the exhibit by the expenditure of a few extra hundreds of dollars. The impression is that at least twice as many exhibits could have been arranged in the same amount of space with better results.

Ford has a complete display, including an assembly plant which shows a few of the major operations in the assembly of this car, such as mounting the motor, body, adding the radiator and hood, and starting the motor by the same method as used in the factory. There are some thirty men at work in his exhibit and often fifty to seventy-five spectators quite interested in the operation.

The present exhibit cannot be looked upon as an active sales exhibit, such as an annual automobile show. Some of the factory exhibits have men in attendance and in several cases two or more makes are grouped together under the name of the local agent. Little or no trade literature is being distributed and there does not seem to be much demand for it. After wandering through the different buildings the visitor is almost forced to conclude that the automobile exhibit is not getting its share of the people, but this may be due to the season being somewhat early so far as the show is concerned.

At one of the exhibits it was stated that two cars had been sold, but at many others no sales were made and little effort was being made to make sales or get the name of prospects. From what you could judge from a casual observation, it would seem that many of the local dealers simply view the exposition as a dead exhibit.

Among those exhibiting are Ford, Overland, Buick, Studebaker, Maxwell, Hupmobile, Cadillac, Jeffery, White, Mitchell, Hudson, Packard, Interstate, Westcott, Kissel, Oakland, Briscoe, Saxon, Moline, Oldsmobile, Pierce truck, Federal truck, Sterling truck, Menominee truck and one or two motorcycle manufacturers. The exhibit of automobiles seems practically complete with the exception of Buick, whose space is still empty.

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Milwaukee's Progressive Show a Success

MILWAUKEE, WIS., April 19—Something new in the way of automobile shows was introduced here on Saturday and Sunday, April 17 and 18, under the name of "Progressive Auto-

mobile Show" by the Milwaukee Automobile Dealers, Inc., the new trade organization supplanting the Milwaukee Automobile Dealers' Assn., existing since 1910. The show was a decided success.

The progressive show idea consists of private exhibits of cars and chassis in the individual showrooms, as distinguished from the annual show held in the Auditorium in January of each year. Each of the thirty-two members of the association had an exhibition of the latest models and stripped and cut-out chassis such as usually are furnished for winter show purposes.

Nearly 100 demonstrating cars, bedecked with signs reading: "Progressive Auto Show—Get In" were used to transport show visitors from one place to another. After an individual or a group had inspected the models in one showroom, he or they were asked if they wanted to look at other displays and then invited to take a free ride to whichever salesroom they desired to go. The next dealer repeated the process.

All field men and salesmen were called in by the respective houses to wait on the trade during the 2 days. Scores of sub-agents and independent dealers from all parts of the state attended.

Fifty different factories were represented in the show by the thirty-one Milwaukee dealers comprising the association. Many lesser agents not members of the association made special displays, but did not have the benefit and advantage of the transportation system supplied by the organization and had to be content with as many prospects as free will afforded them.

Developments in the Jitney Bus Field

Tennessee Defines Jitneys as Common Carriers

MEMPHIS, TENN., April 15—The Legislature has passed a bill for the regulation of jitneys. The measure defines them as common carriers and prohibits their operation in any city or incorporated town without permit or license from the municipal authorities. It requires the furnishing of a bond, in a sum to be fixed by the municipality but in no case to be less than $5,000 for each car operated, to insure the payment of any damage that may occur. It empowers the municipalities to fix the terms of operation, prescribe the routes and impose a tax for the exercise of the privilege granted.

R. I. Jitney Liability Plan Is Adopted

PROVIDENCE, R. I., April 17—The Rhode Island Jitney Bus Owners' Assn. held a meeting last week and adopted by-laws which touched directly on the liability of the jitney in case of negligence on the part of the driver.

The substance of the by-laws is that any settlement or judgment levied upon any member of the association is to be borne by the entire association by a pro rata assessment.

LOS ANGELES, CAL., April 14—Representatives of the Los Angeles Auto Bus Owners and Operators Assn. filed with the City Clerk their initiative ordinance petition yesterday. Officers of the association claim that there are 13,333 names on the petition and that they are sure of the 5 per cent. qualified names necessary to place the ordinance before the people at the next general municipal election.

The Jitney Bus Assn.'s ordinance provides for no indemnity bond or insurance and it reduces the license tax from $60 to $12 per year.

All jitney buses must be equipped with non-skid tires on the rear wheels and when such tires are worn smooth and when the surface of the street is wet, the rear wheels must be equipped with tire chains. These provisions, however, are not to become effective until 90 days after the ordinance is passed.

Houston Jitney Ordinance Declared Void

HOUSTON, TEX., April 15—The jitney ordinance recently passed by the city of Houston was held to be unconstitutional and void by Judge William Masterson. The provision requiring a bond of $10,000 formed an important element in the case. It was understood that the city would be willing to withdraw this feature and amend the ordinance accordingly.

PAWTUCKET, R. I., April 16—As a result of the introduction of the jitney service in Pawtucket, the trolley company has cut its service. Lack of patronage is the reason given by the officials.

Quaker Jitneys Make $10 a Day

PHILADELPHIA, PA., April 17—In the short space of a few weeks the jitney bus has grown from nothing to an established trade in which hundreds of persons are engaged earning from $5 to $10 daily, has cut into the earnings of the Philadelphia Rapid Transit Co. to an alarming extent and has had the effect of making the general public more or less indifferent regarding the outcome of the Broad street subway project, a rapid transit program that was uppermost in the public mind until the advent of the jitney. Every day sees additional cars put on the streets, until now all count has been lost and their numbers can only be estimated. These estimates vary from 400 to 650 and the little buses are multiplying with remarkable rapidity.

Figures gleaned from inquiry among half a dozen operators of jitneys ranging from the smallest car to the largest as to operating cost cover a wide range and are mostly based upon estimates, few of the drivers having the time or the inclination to keep accurate accounts.

One operator of a 5-passenger bus claimed daily average receipts of $8, with operating expenses of $2.50, allowing for gasoline and oil consumption and depreciation. This does not, however, take into account any outlay for new tires.

Another operator of a larger car computes his expenses as only averaging $2.25 a day, whereas his receipts are as high as $15 some days.

A third averages $10 in receipts and $4 in expenses, while a fourth, having a shorter route to cover claims receipts as high as $13.35 and expenses about $3.80.

N. Y. to Curb Jitney Buses

ALBANY, N. Y., April 21—By a vote of 81 to 42 the Assembly today passed the Thompson bill, placing jitney buses under the supervision of the Public Service Commission. In its original form the Thompson bill excluded New York City. The bill was later amended to cover New York City, too. Under its provisions jitney bus companies, before beginning operation, must secure not only the consent of the Board of Estimate, but also a certificate of convenience and necessity from the Public Service Commission. The bill passed the Senate last week by a vote of 27 to 18. The bill now goes to the Governor.

Jitney Service Suspended in Spokane

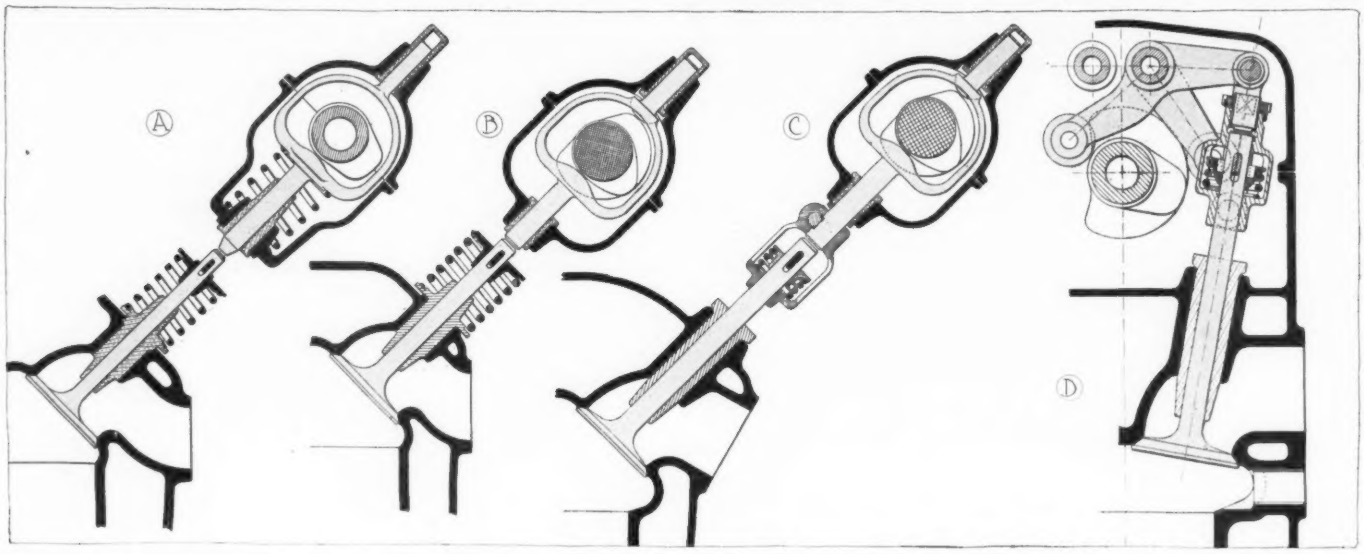
SPOKANE, WASH., April 15—Cheap automobile service was suspended yesterday by order of the police department. All 5-cent fare automobile drivers and a number of other owners of rented machines were forced by the police to suspend operation until they complied with the state law calling for a $2,500 bond and a state license. Until the drivers of the machine have secured permits under the new city ordinance they will not be permitted to operate in Spokane.

As the taxicab drivers have obtained a temporary injunction to prevent the enforcement of the bonding clauses of the law against them the taxicab companies have not been molested as yet. The legislation seems to be directed against the jitney operators.

3-Cent Jitney in Atlantic City

ATLANTIC CITY, April 15—Several Jitney buses appeared on the streets of this city displaying 3-cent signs. This is taken as a criterion that already a rate war is on among the rivals in this field. Another addition is a cyclecar, capable of carrying two passengers with the driver. A pay-as-you-enter line is scheduled to make its appearance on May 1.

RICHMOND, VA., April 19—Judge Crump, of the Law and Equity Court, ruled today that the courts have no right to interfere with the operation of jitney buses. This was a defeat for the traction company, which had sought an injunction against the jitneys.



Figs. 14A, B, C and D—Various methods of valve operation, showing means for positively lifting the valve and returning it to its seat

European High-Efficiency Motors—Part II

(*Continued from page 729.*)

The valves of high speed motors must be made of special steels. These organs have not only to withstand excessive vibration but also the high temperature of the exhaust gases. It is therefore necessary to have steels capable of resisting very high temperatures, which may be as high as 572 degrees F., and of withstanding a pressure of 114,000 pounds per square inch. Steel makers have given this problem their close attention and have produced high nickel steels capable of fulfilling all requirements. Although, as the result of modern progress, it has been possible to reduce the weight of valves very considerably, perfection has been sought in another direction. However, carefully valve springs are made, they never have a very long life, as can be readily perceived when it is remembered that the set of valve springs absorb and give about 4 horsepower on a 130-horsepower Grand Prix motor. With the finest possible steel valve springs which have to withstand 2,000 vibrations a minute cannot possibly have a long, useful life. Sooner or later, the metal shows signs of fatigue, and in consequence the timing is modified and the valve no longer closes correctly.

On this account it has been sought to abolish the valve springs in motors capable of 4,000 r.p.m., and by means of a light spring having but three-tenth millimeters stroke, ensure the closing of the valve and its gas-tightness. Fig. 14A shows a valve operation for a motor having either two or four valves placed in the head of the combustion chamber. The valves and the pushrods are each operated by a separate spring; it will be noted that the valve is relatively light in order that the spring may be capable of assuring its return. In Fig. 14B the valve is returned by a spring and the pushrod by a second cam placed by the side of the main cam. The pushrod spring has of course become useless and has been abolished.

Fig. 14C shows the positive valve control which constitutes the greatest perfection of the present time. The valve and the pushrod are mechanically operated. A stirrup-shaped member is keyed to the pushrod and with an intermediary spring it assures the return of the valve. The spring only serves to maintain the valve in contact with the valve seat; it is therefore possible, in the case of twin valves, to operate them by means of a double cam and a single stirrup.

Fig. 14D shows a design with a single camshaft and two series of valves, one on each side of the motor. Twin intake or exhaust valves can have the same double cam, and the connecting organ between the operating lever and the cam can be made in any appropriate manner. It is to be noted that in the designs Fig. 14C and Fig. 14D the valves are relatively heavy and are in consequence free from the possibility of breakage.

It may be asked why detachable valve seatings are not employed, as is the case in other motors. The reason is that it is absolutely necessary to cool the valve seats—the intake as well as the exhaust. The pocket and the ribs of a separate valve cage offer such a resistance to the passage of the gases as seriously to interfere with the correct working of the motor.

(To be continued)

Steel—Its Pathology—Part III

(*Continued from page 731*)

of 1,050 degrees Centigrade, plain Austenite with its characteristic polygonal grains will be produced.

Vanadium Forms a Double Carbide

Vanadium forms a double carbide with carbon and iron and this forms one of the independent portions of the mixture when the amount of vanadium in the steel is in excess of 7 per cent. When the vanadium present is less than this the Pearlitic structure is secured and a much stronger resulting mixture is obtained. The separation of the brittle double carbide in forming an independent mixture tends to increase the brittleness of the resulting alloy. Hence it is found that in pure vanadium steels more than .5 per cent. is rare. It is kept below the double carbide danger.

Tungsten is another alloy which forms a double carbide and hence must be used below the percentage at which the brittle double carbide separates itself from the other materials in the mixture. The structure of the tungsten steel is Pearlitic until the percentage of tungsten reaches a higher percentage than 10, at which time the double carbide separates. There is no intermediate or Martensitic stage with this alloy. The effect of the tungsten is to increase the tensile strength and hardness without increasing the brittleness until the double carbide separates itself.

Some of the alloy steels are self-hardening; Mushet steel, which is a tungsten alloy having a percentage of 8.3 tungsten and 1.73 manganese, is an example of this. Other steels, however, have to be quenched in certain cooling agents in order that they reach their proper characteristics. Some of the cooling agents commonly used are mercury, diluted sulphuric acid, salammoniac, salt, carbonate of lime, various

kinds of oils, tallow, wax and even sweet milk. Some alloys require a double quenching, being heated to one temperature and plunged into one cooling agency and then heated to another and plunged into a different cooling agency.

Steels should be brought back to their proper structure after every operation which is apt to disturb them, by annealing. In order to prevent oxidization of the surface of the steel the piece to be annealed is usually packed in a cast-iron box with some charcoal, charred bone, fire clay or some other ingredient which precludes the possibility of oxygen reaching the surface. Slow cooling after annealing generally gives the best results. The Society of Automobile Engineers specifies a number of heat treatments, some of which are herewith appended.

Examples of S. A. E. Heat Treatments

Heat Treatment A

After forging or machining:
1. Carbonize at a temperature between 1600° F. and 1750° F. (1650°-1700° F. desired.)
2. Cool slowly or quench.
3. Reheat to 1450°-1500° F. and quench.

Heat Treatment B

After forging or machining:
1. Carbonize at a temperature between 1600° F. and 1750° F. (1650°-1700° F. desired.)
2. Cool slowly in the carbonizing mixture.
3. Reheat to 1500°-1550° F.
4. Quench.
5. Reheat to 1400°-1450° F.
6. Quench.
7. Draw in hot oil at a temperature which may vary from 300° to 450° F., depending upon the degree of hardness desired.

Heat Treatment H

After forging or machining:
1. Heat to 1500°-1550° F.
2. Quench.
3. Reheat to 600°-1200° F. and cool slowly.

Heat Treatment K

After forging or machining:
1. Heat to 1500°-1550° F.
2. Quench.
3. Reheat to 1300°-1400° F.
4. Quench.
5. Reheat to 600°-1200° F. and cool slowly.

Heat Treatment L

After forging or machining:
1. Carbonize at a temperature between 1600° F. and 1750° F. (1650°-1700° F. desired.)
2. Cool slowly in the carbonizing mixture.
3. Reheat to 1400°-1500° F.
4. Quench.
5. Reheat to 1300°-1400° F.
6. Quench.
7. Reheat to 250°-500° F. and cool slowly.

Heat Treatment M

After forging or machining:
1. Heat to 1450°-1500° F.
2. Quench.
3. Reheat to a temperature between 500° F and 1250° F. and cool slowly.

Heat Treatment P

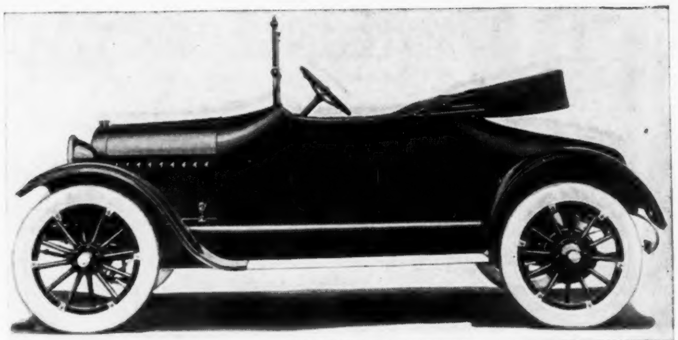
After forging or machining:
1. Heat to 1450°-1500° F.
2. Quench.
3. Reheat to 1375°-1425° F.
4. Quench.
5. Reheat to a temperature between 500° F. and 1250° F. and cool slowly.

Heat Treatment Q

After forging:
1. Heat to 1475°-1525° F. (Hold at this temperature one-half hour, to insure thorough heating.)
2. Cool slowly.
3. Reheat to 1450°-1500° F.
4. Quench.
5. Reheat to 250°-550° F. and cool slowly.

Heat Treatment S

After forging or machining:
1. Carbonize at a temperature between 1600° F. and 1750° F. (1650°-1700° F. desired.)
2. Cool slowly in the carbonizing mixture.
3. Reheat to 1600°-1700° F.
4. Quench.
5. Reheat to 1475°-1550° F.
6. Quench.
7. Reheat to 250°-550° F. and cool slowly.



New Inter-State roadster which sells for $1,000, completely equipped

Inter-State Adds Roadster

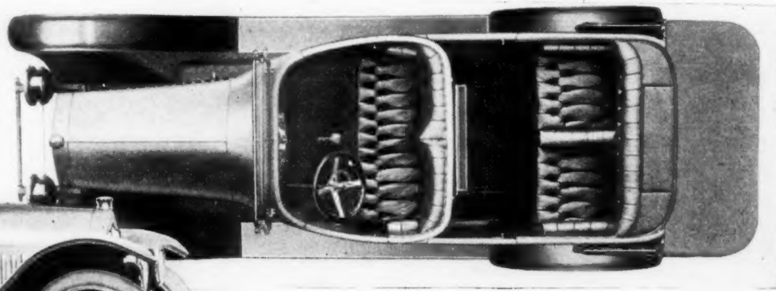
MUNCIE, IND., April 16—The Inter-State Motor Co., Muncie, Ind., announces it has added a roadster model which, like the touring car, will sell for $1,000, completely equipped. This new model is built on the same standard chassis as the touring car, the block motor being of the overhead valve type and having 3 1-2 by 5-inch cylinders with a removable head. Among the special features are exceptional leg room and a commodious compartment at the rear which provides storage for two tires mounted on rims. Access to this compartment is through a door which lets down and forms parts of the body when locked. Another unusual feature is a baggage compartment behind the seat and large enough for the contents of a small steamer trunk. Access to this compartment is through a door on top of the back of the seat which may be opened with the top either up or down. The body itself is of the streamline type mounted on a wheelbase of 110 inches.

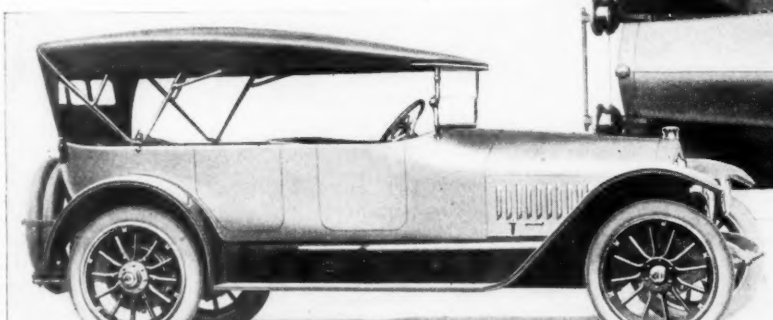
1½-Ton Garford Is Worm Driven

LIMA, O., April 15—First details of the second size Garford truck which is being produced by the Garford Motor Truck Co. have been made public. The vehicle is of conventional appearance, is rated at 1 1-2 tons capacity and is worm driven; the chassis lists at $1,800. Right drive is standard, though left drive with center control is optional. The motor has four L-head block cylinders 3 3-4 by 5 1-2 and drives through a multiple-disk clutch, three-speed gearset and full-floating axle. Ignition is by high-tension magneto and a Rayfield carbureter is used. Solid tires, either demountable or pressed on, are used, 36 by 3 1-2 front and 36 by 5 rear. The equipment includes odometer, curved steel dash, two oil lamps set flush in dash, oil tail lamp, driver's seat with cushions and separate folding back, and the usual set of tools. Electric lighting and starting are extra.

RACINE, WIS., April 15—The J. I. Case T. M. Co., Racine, Wis., has perfected a new type of three-wheeled farm tractor designed especially for use on marshy and swampy land. Fifty of the new machines are now coming through and a large production is planned during the remainder of the year. The design is somewhat unusual in that one wheel is set off to one side while the other two follow each other in tandem form.

A New National



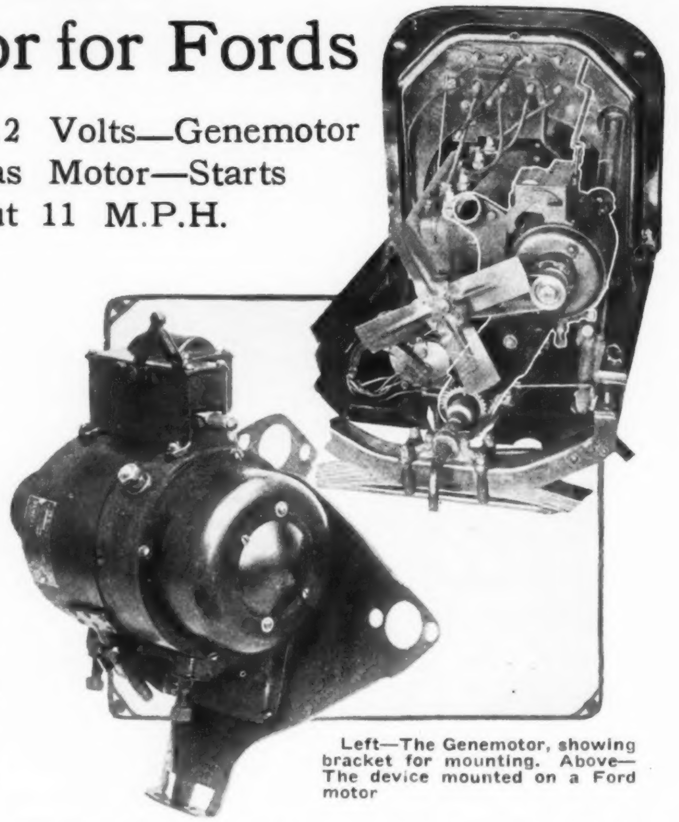


The new National four-passenger Newport model with toy tonneau. Features are optional, divided rear seat and arm rests for all seats below body parapet. Center arm of rear seat contains a glove box and back of the rear seat is a large baggage-carrying compartment. The new body is mounted on the six chassis and sells for $2,375

G. E. Motor-Generator for Fords

Single Electrical Unit Wound for 12 Volts—Genemotor Develops 45-Foot-Pounds Torque as Motor—Starts Charging as Generator at About 11 M.P.H.

THE starting and lighting system outfit placed on the market by the General Electric Co. for Ford cars, and known as the Genemotor, shows a very successful use of the motor-generator system. The principal mechanism consists of the single electrical unit wound for 12 volts which operates as a generator or motor as the case may be and the necessary accessories for attaching this to the Ford car and operating it. The battery used in connection with the outfit is a six-cell 42-ampere hour unit manufactured by the United States Light & Heating Co., especially for use with this system.

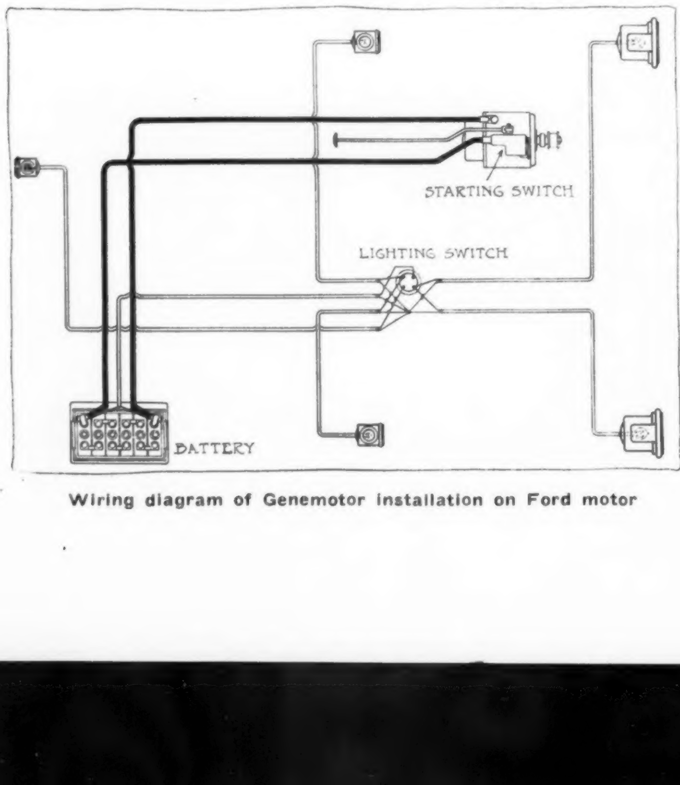


Left—The Genemotor, showing bracket for mounting. Above—The device mounted on a Ford motor

Is Readily Attached

The Genemotor is cylindrical and fully inclosed, about 10 inches long overall, 7 inches in diameter and weighs about 52 pounds. It is supported rigidly on the right-hand side of a Ford engine, viewed from the front, by a pressed steel bracket secured at three points. This bracket can be attached without drilling or tapping any holes. The base of the bracket rests on the lower flange of the engine frame and is fastened to it by the bolts holding the crankcase up to the body of the engine. The front upper support is formed by a portion of the bracket that is clamped between the cylinder head casting and the nozzle through which the water circulating around the engine cylinders passes to the radiator. The third point of support is effected by clamping a portion of the bracket between the main cylinder casting and the nozzle through which the cooling water passes from the radiator around the cylinders. The Genemotor itself, being circular, is carried on a malleable iron support riveted to the bracket. The position of the Genemotor on this support is determined by suitable adjusting screws, and it is rigidly clamped in position by means of a steel band provided with a suitable tension screw. This method of mounting permits adjustment of the Genemotor both for alignment of the sprocket gears and tension of the driving chain. The installation is fully covered and protected by the engine hood when the latter is closed.

As a motor, the Genemotor will develop a torque of about 45-foot pounds, and the torque developed at the engine shaft by means of the selected gear ratio has been found amply adequate to start a Ford motor under very severe conditions of tight adjustment and cold water. The storage battery is carried on the right running board of the car, and is employed to accumulate current while the car is in motion for supplying the starting and lighting system when the car is at rest.



Wiring diagram of Genemotor installation on Ford motor

Acting as a Generator

When the car has attained a speed of about 11 miles per hour, the Genemotor, acting as a generator, develops an electromotive force sufficiently high to overcome the normal voltage of the battery and permit charging to take place. At this point, the reverse current relay operates, closing the circuit between the generator and battery, and charging begins at a low rate, the current gradually increasing as the speed of the car increases to a maximum of slightly over 10 amperes.

A suitable, twenty-six-tooth, steel sprocket is mounted on the engine shaft at the point where the crank is ordinarily applied. A thirteen-tooth steel pinion, mounted on the motor shaft, drives this sprocket and thus the engine through a silent chain of special design. The Genemotor is running either idle, as a motor, or as a generator, at all times while the engine is in motion, and thus all clutches can be eliminated. The fan is driven by a belt from the Genemotor shaft pulley, mounted outside of the sprocket, to a split pulley provided for clamping onto the standard fan pulley.

The main switch and reverse current relay are mounted in an inclosed metallic case on top of the Genemotor and are readily accessible. The switch, which controls the motor, is closed through a cam actuated by a pushrod extending through the dashboard of the car and terminating in a knob conveniently located near the steering wheel column. The contacts are of the multiple leaf pattern and the switch is provided with a mechanism that assures a quick break on opening. The reverse current relay prevents current feeding back to the generator when the latter is operating at low speed or when the engine is not running. The wiring system is metallic throughout, no ground return being used.

With complete equipment, exclusive of lamps, the Genemotor retails to the user at $75 and the system can be readily installed by anyone with a fair degree of mechanical knowledge, or at any garage at reasonable cost. It is distributed by A. J. Picard & Co., New York City.

Factory Miscellany

WASHINGTON Assembling Plant for Ford—An assembling plant is to be built by the Ford Motor Co., in Washington, D. C., this summer. It will probably be a four-story structure, 100 by 400 feet, and similar in general design to the several assembling plants recently completed in other large cities for the Ford company. With the plant in Washington, the Ford company will have twenty-five distributed in eighteen different states. It is also reported that assembling plants are to be started this year in the states of Kansas and Iowa. In fact, it is said to be the plan of the company to have eventually one or several assembling plants in every state of the Union and also in those foreign countries where the growth of the Ford business will warrant it. Construction work will be started within a few days upon the plant to be located in Buffalo, N. Y. This will be a four-story structure somewhat irregular in shape, with a maximum length and width of 100 and 400 feet.

To Mfr. Automobiles—P. A. Seeker, Marine City, Mich., has purchased land at London, Ont., for an automobile factory to cost $65,000.

Carr Rubber to Add—The F. S. Carr Rubber Co., Superior street, Tilbury, Ont., will build an addition to its factory. Plans are being prepared.

Locomobile to Add — The Locomobile Co. of America, Bridgeport, Conn., has plans for erecting a four-story manufacturing addition on its Seaside park property.

Siro Carburetor Plant Damaged—Fire April 4 damaged the plant of the Siro Carburetor Mfg. Co., Pleasant street, Northampton, Mass. The loss was $5000.

To Mfr. Tire Pressure Gauge—J. F. McDonald, Nevada, Ia., contemplates constructing a factory for the manufacture of a device for gauging the pressure on automobile tires.

Elyria Tire to Build—The Elyria Tire & Rubber Co., Elyria, O., will shortly begin the erection of a brick, steel and concrete plant, 80 by 106 ft., for the manufacture of hard rubber tires for automobile trucks.

Preparing for Cuyahoga Addition—A large force of men has been placed at work clearing up the recently acquired land at Main and Broad streets, Cuyahoga Falls, O., preparatory to erecting a factory building by the Falls Rubber Co.

Fisk to Add—The Fisk Rubber Co., Chicopee Falls, Mass., will build an addition of brick and steel construction, 50 by 30 feet, and six stories high, to connect the buildings of the plant. It will be completed in about 6 weeks. The company will probably make further additions.

Fire at Premier Plant—The trainer shed of the Premier Motor Mfg. Co., Indianapolis, Ind., was destroyed on April 9. The origin of the fire is unknown. The loss, estimated at $6,300, is fully covered by insurance. The building containing valuable patterns of the company was threatened for a time, but was saved through the efforts of the fire department.

Parts Co. Makes Improvements—The Werra Aluminum Co., Waukesha, Wis., aluminum castings, is making changes and improvements in its foundry and machine shop to gain additional room made necessary by the tremendous rush of business. The plant has been on a day and night schedule for some time. Its trade for the most part is for automobile and engine parts.

Touraine Co. Adds Two Plants—The Touraine Co., southwest corner of Broad and Huntingdon streets, Philadelphia, Pa., manufacturer of the Vim light delivery car, has added two factories to their equipment, one at Twentieth street and Montgomery avenue, that city, which will be used as production headquarters, and the other at North Wales, Pa., where in the future all bodies for the Vim will be built.

Falls Machine Busy—The Falls Machine Co., Sheboygan Falls, Wis., is working two 10-hour shifts, the greatest capacity ever reached by the plant, on large orders for motor car engines. The direct cause of the unusually heavy operations is an order for 6,000 6-cylinder engines for the Grant Motor Co., Findlay, O. More than 200 skilled operatives are now at work, compared with about eighty-five at the beginning of the year.

Racine Co. Mfg. Bolster Springs—The Harvey Spring & Forging Co., Racine, Wis., a large manufacturer of springs and forgings for motor and automobile manufacturers in the middle west, has started a large production of a new type of bolster spring for heavy duty vehicles which is the outgrowth of experimentation in its automobile spring business. The spring is being made in a simple form for application to vehicle already in use without reconstruction.

Packard Establishes Shipping Record—On April 12 the Packard Motor Car Co., Detroit, Mich., established a new record by shipping the largest number of motor vehicles turned out in any one day since the company started in business. The day's output, when loaded aboard freight cars, represented a value of $212,795.

Present reports indicate the April business for the Packard will exceed any previous April in the number of vehicles shipped and, with good weather, it will beat the largest month's record in the company's existence.

The Automobile Calendar

April 22	Detroit, Mich., S. A. E. Standards Divisions to Report.
April 30, May 1-2	Portland, Ore., Track Races; Northwest Automobile Assn.
May 1	Irvington, N. J., track meet; O. V. Matthews.
May 1	Philadelphia, Pa., Quaker City Motor Club, Eighth Annual Sociability Run to Atlantic City.
May 5-6	Detroit, Mich., Motor Truck Convention of the N. A. C. C., Hotel Statler.
May 8	Salem, Ore., Track Races; Northwest Automobile Assn.
May 15-16	Vancouver, Wash., Track Races; Northwest Automobile Assn.
May 15-16	Columbus, O., Track Race, Columbus Automobile Club.
May 17	Spokane, Wash., Show, Davenport Hotel.
May 17-18	Boston, Mass., A. A. A. Annual Meeting.
May 18-19	Boston, Mass., annual meeting of the American Automobile Assn.
May 27	Chicago, Ill., Sociability Run of Chicago Motor Club to South Bend, Ind. H. H. Robinson.
May 29	Indianapolis, Ind., 500-Mile Race, Indianapolis Motor Speedway.
May 29	Philadelphia, Pa., Stone Harbor Memorial Day Run from Philadelphia.
May 29-30	Seattle, Wash., Track Races; Northwest Automobile Assn.
June 3	New York City, 11th Annual Automobile Outing for Orphans; Orphans' Auto. Day Assn. of N. Y.
June 9	Galesburg, Ill., 200-Mile Race, Galesburg District Fair Assn.
June 12	Brighton Beach, Track Race; E. A. Moross.
June 14-17	Detroit, Mich., Summer Meeting of the Society of Automobile Engineers and Start of Cruise to Georgian Bay.
June 19	Chicago, Ill., 500-Mile Race, Chicago Speedway.
July 3	Sioux City, Ia., 300-Mile Race, Sioux City Speedway Assn.
July 4	Visalia, Cal., Road Race; Tulare County Automobile Assn.
July 4-5	Tacoma, Wash., Road Race.
July 5	Omaha, Neb., Speedway Races, Omaha Motor Speedway.
Aug.	Milwaukee, Wis., Independent Petroleum Marketers' Assn. of the U. S.; 1915 Convention in Milwaukee.
Aug. 2-3	San Francisco, Cal., Tri-State Good Roads Assn., Third Annual Convention.
Aug. 20-21	Elgin, Ill., Road Race.
Sept.	Indianapolis, Ind., Fall Show, Indiana State Fair.
Sept. 6	Providence, R. I., Speedway Race; F. E. Perkins.
Sept. 6	Detroit, Mich., Speedway Race; Detroit Speedway Club.
Sept. 13	Oakland, Cal., Pan American Road Congress.
Sept. 20-25	San Francisco, Cal., International Engineering Congress.
Oct. 1-2	Trenton, N. J., Track Races; Inter-State Fair.
Oct. 6-16	New York City, Ninth Electrical Exposition and Motor Show at Grand Central Palace.
Dec. 31	New York City, Show; Grand Central Palace.
Jan. 22, 1916	Chicago, Ill., Show; Coliseum.

ACCESSORIES

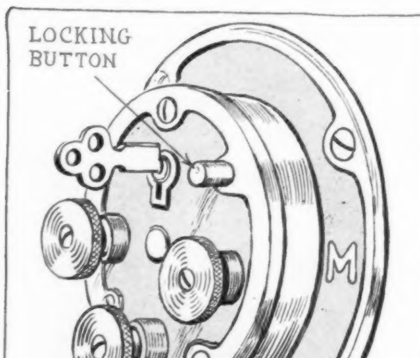
Beartone Pump, Horn and Fan

THE Beartone combination horn, fan and tire pump has been put on the market. This accessory is designed primarily for Ford cars but will be supplied for all makes. The pump, which follows the latest practice in motor design, is a single-cylinder 1 1-2 by 1 1-4 inches bore and stroke respectively and is driven from the fan by a worm gear. The pump cylinder is of

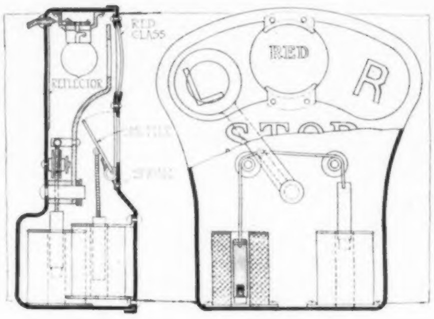
Oakes combination pump, horn and fan

gray iron and the pistons are fitted with ground rings and bronze connecting-rod.

Lubrication is provided by a wick oiler which, while insuring constant lubrication prevents a spray of oil being pumped into the tires. The hub of the fan is cored to carry sufficient grease for lubricating the bearings for a year, a grease cup mounted on the bracket making it possible to oil the fan while in motion. The pump is furnished complete with air



Lock for Connecticut ignition system



Pomeroy's direction indicator

hose and automatic gauge. If this gauge is set for a certain tire pressure, when this has been reached the gauge pops off, preventing the tire from being over inflated. The range of the gauge is from 40 to 120 pounds. Of course, the pump is thrown into engagement only when it is desired to inflate a tire. To engage the pump, the lever A is pressed, engaging the gear on the pump with that on the fan. If desired the pump may be carried in the toolbox and attached by merely tightening the hand nut B.

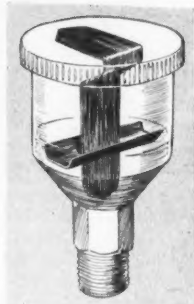
The fan-horn-pump unit is interchangeable with the fan on the Ford, requiring less than 10 minutes for mounting, according to the maker. The price of the combination will be $12.50 each. The maker will also market easily installed fan pumps listing at $7.50 with hose and gauge complete.—The Oakes Co., Indianapolis, Ind.

Direction Signal

This signal provides the red rear light and also indicates Left, Right and Stop. The drawing shows electrical operation, there being three solenoids; two operate the swinging indicator lever to show L or R and the third controls a shutter which normally covers up the stop signal. Electric contacts are arranged on the steering wheel so that movement in either direction swings over the right and left lever, and for the stop signal there is a separate push button. In this form the apparatus costs $12 but it can be had without the stop signal for $9. Another pattern selling for $9 or $5, is the same in effect but has wire rope mechanical operation instead of the solenoids.—B. H. Pomeroy, Rochester, N. Y.

Lock for Connecticut Switch

To afford the car owner adequate means of preventing tampering with his Connecticut ignition system, the company has devised a simple lock which requires the use of a key only for unlocking it. It may be easily installed on any Connecticut automatic ignition switch now in use and hereafter is to be standard equipment. The lock is fitted to the inside of the switch button plate and is therefore completely inclosed. A feature of the new lock is that no key is required to lock the ignition though one must be used to unlock it. Furthermore it is impossible to lock any of the buttons in the On position. To the standard switch button face plate has been added a small button which when depressed operates the locking mechanism. To unlock the switch the key is inserted and given a one-half turn.



Klicket ratchet grease cup

The device is attached to existing Connecticut automatic ignition switches by removing the three screws that hold the switch button plate which is taken off. During this operation each of the buttons must be in the Off position. The new plate is then put on.

The new plate and lock lists at $2.50 and is for replacement of the old plate only, which must be returned when the new one is installed. All keys are numbered corresponding to a number which appears on the locking button. Extra keys are 15 cents.—Connecticut Telephone and Electric Co., Meriden, Conn.

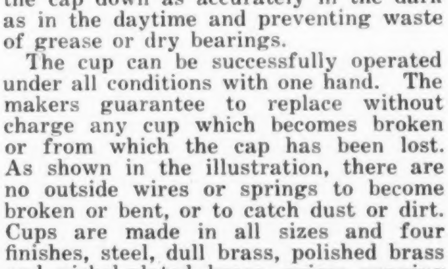
Klicket Ratchet Grease Cup

With this grease cup it is always possible to tell exactly how much grease has been forced into the bearings. Also, as soon as the cap catches the thread, the simple interior ratchet device gives a click and clicks at every quarter turn thereafter, making it possible to turn the cap down as accurately in the dark as in the daytime and preventing waste of grease or dry bearings.

The cup can be successfully operated under all conditions with one hand. The makers guarantee to replace without charge any cup which becomes broken or from which the cap has been lost. As shown in the illustration, there are no outside wires or springs to become broken or bent, or to catch dust or dirt. Cups are made in all sizes and four finishes, steel, dull brass, polished brass and nickel-plated brass, prices ranging from 15 cents upwards.—American Stamping Co., Battle Creek, Mich.

Another Piston Ring

The Smith "Metallic" piston ring is one of the latest attacks upon the problems that surround piston ring making. Even pressure on the cylinder wall all round is obtained by the use of the superimposed ring principle, but the two rings are one above the other instead of there being an inner and an outer ring. There is a lip projecting upwards all round one ring, and a groove to correspond is cut in the other member. The ends of one ring come at a different point than the ends of the other so there is no slot right across the face as with the plain type of ring. The price is $1.50.—William V. Smith, Schenectady, N. Y.



Smith Metallic piston ring and section